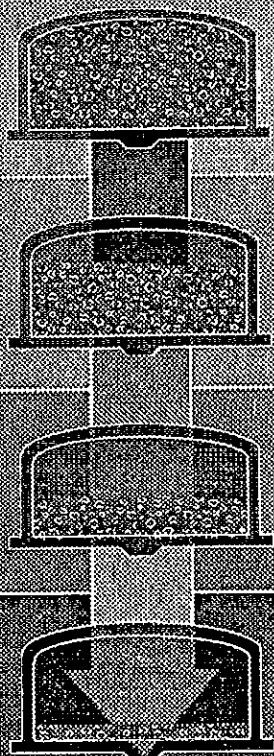


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Draft Environmental Impact Statement for the Tank Waste Remediation System

Volume Five



Appendix G: Air Modeling
Appendix H: Socioeconomic Impact Modeling
Appendix I: Affected Environment
Appendix J: Consultation Letters



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APPENDIX G

AIR MODELING

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ACRONYMS AND ABBREVIATIONS

CPF	Capsule Packaging Facility
DST	double-shell tank
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information System
HLW	high-level waste
ISC2	Industrial Source Complex Model
LAW	low-activity waste
TWRS	Tank Waste Remediation System
WAC	Washington Administrative Code
WESF	Waste Encapsulation and Storage Facility

NAMES AND SYMBOLS FOR UNITS OF MEASURE AND RADIOACTIVITY

Length		Area		Volume	
cm	centimeter	ha	hectare	cm ³	cubic centimeter
ft	foot	ac	acre	ft ³	cubic foot
in.	inch	km ²	square kilometer	gal	gallon
km	kilometer	mi ²	square mile	L	liter
m	meter	ft ²	square foot	m ³	cubic meter
mi	mile			ppb	parts per billion
				ppm	parts per million
				yd ³	cubic yard
Mass		Radioactivity			
g	gram	Ci	curie		
kg	kilogram	mCi	millicurie (1.0E-03 Ci)		
mg	milligram	μCi	microcurie (1.0E-06 Ci)		
lb	pound	nCi	nanocurie (1.0E-09 Ci)		
mt	metric ton	pCi	picocurie (1.0E-12 Ci)		

APPENDIX G

AIR MODELING

G.1.0 INTRODUCTION

This appendix describes the air dispersion modeling that was performed to assess the impacts on air quality resulting from normal operations associated with the various Tank Waste Remediation System (TWRS) alternatives. The analyses were conducted to accomplish the following objectives:

- Compare the analyzed impacts of potential criteria pollutant releases against National Ambient Air Quality Standards and applicable Washington State regulations;
- Compare the analyzed impacts of emissions of toxic and hazardous air pollutants against applicable Washington State regulations; and
- Compare the analyzed impacts of emissions of radionuclides against applicable Washington State and Federal standards.

The following sections describe the proposed Hanford Site TWRS alternatives, and discuss the dispersion models used in the analyses. The remaining sections describe the methodology of the modeling approach, the data used as input to the model (meteorology, source, and receptor parameters), and the results of the modeling effort.

G.2.0 DESCRIPTION OF ALTERNATIVES

The remedial alternatives are broadly separated into those activities related to remediating the tank waste, and those activities involving remediation of the cesium and strontium capsules. The following alternatives were studied:

- Tanks Waste Alternatives
 - No Action - The waste is maintained in the existing tanks.
 - Long-Term Management - The double-shell tank (DST) waste is transferred to newly constructed DSTs. The tanks will be replaced twice, at 50-year intervals.
 - In Situ Fill and Cap - Waste would be disposed of in situ by filling the tanks with gravel and placing a Hanford Barrier over them to inhibit infiltration of rain water or human intrusion.
 - In Situ Vitrification - The waste contained in the existing storage tanks would be vitrified in-place.
 - Ex Situ Intermediate Separations - The Intermediate Separations alternative would involve separating the tank waste into high-level waste (HLW) and low-activity waste (LAW) and vitrifying the waste. The LAW would be disposed of onsite in subsurface vaults, and the HLW would be shipped offsite for disposal at the potential geologic repository.
 - Ex Situ No Separations - Under the vitrification option, the waste would be immobilized as glass cullet. Under the calcination option, the waste would be treated at temperatures below those required for vitrification, with a resulting

- dry-powder waste form. All of the treated waste would be shipped offsite for disposal at the potential geologic repository.
- Ex Situ Extensive Separations - This is an extension of the Ex Situ Intermediate Separations alternative. The difference is that waste would undergo a more extensive series of processing steps that would result in a smaller volume of HLW and a larger volume of LAW. Vitrification and disposal activities would be similar to those in the Ex Situ Intermediate Separations alternative.
 - Ex Situ/In Situ Combination - This alternative is a combination of the Ex Situ Intermediate Separations alternative and the In Situ Fill and Cap alternative. Approximately one-half of the tanks would be filled and capped and half of the waste would be recovered from the remaining tanks, separated into LAW and HLW, and vitrified. The LAW would be disposed of onsite in LAW vaults, and the HLW would be shipped offsite for disposal at the potential geologic repository.
 - Phased Implementation - For the first phase of this alternative, two demonstration vitrification facilities would be built and operated. One facility would treat LAW, while the other would separate and treat LAW and HLW streams. For the second phase of this alternative, the facilities from the first phase would continue to operate and large-scale facilities would be built to separate the tank waste into HLW and LAW. The LAW would be disposed of onsite in subsurface vaults, and the HLW would be shipped offsite for disposal at the potential geologic repository.
- Cesium and Strontium Capsules Alternatives
 - No Action - The capsules would be maintained in the Waste Encapsulation and Storage Facility (WESF).
 - Onsite Disposal - The capsules would be transferred from their existing location to a newly constructed Dry-Well Storage Facility.
 - Overpack and Ship - The capsules would be retrieved from their existing location, transferred to a newly constructed repackaging facility, repackaged, and transferred to a storage location pending future disposal at the potential geologic repository.
 - Vitrify with Tank Waste - The capsules would be retrieved, and the contents would be vitrified along with the HLW.

G.2.1 SOURCE IDENTIFICATION AND CHARACTERIZATION

Reviewing available data resulted in identifying several locations and processes expected to emit air pollutants (WHC 1995c, j, n, and Jacobs 1996). The following discussion describes the location and nature of each of these sources. Section G.2.2 details the manner in which these sources were grouped to analyze each alternative. Section G.3.1.2 discusses the emission rates assigned to each source for each alternative.

Pollutant emitting activities were depicted as either area sources or point sources in the dispersion models. Area sources are used for simulating emissions that exist in a known area of activity, especially if the exact source locations are unknown or are expected to move from time to time. In other words, the emissions occurring within the area need not be uniform over space or time. Area sources are defined in the model as square areas and are assigned an areal emission rate (typically specified as grams per square meter per second [$\text{g}/\text{m}^2/\text{s}$]). In this study, the area sources were chosen to include the area in which most of the emissions from a particular operation or grouping of sources would be expected to occur.

Point sources are used for simulating the emissions from sources that are expected to remain in a fixed location and are vented through a stack. The models consider the effects of elevated release heights, building downwash, release temperature, and release velocity when calculating predicted concentrations from point sources. Figure G.2.1.1 shows the source locations used in the modeling scenarios.

Tank Farms

Area sources were used to represent logical groupings of tanks and tank farms. Locations of all sources for all alternatives are shown in Appendix B. Eleven such groupings (identified as TF1E through TF11E) were assigned to tanks in the 200 East Area, while six groupings (TF1W through TF6W) were assigned to the tanks in the 200 West Area. Air emissions that are assumed to occur in these areas include:

- Vehicular emissions associated with construction activities at these sites; and
- Emissions of radiological and nonradiological components from the tanks for all alternatives during continued operations, retrieval, and gravel filling operations.

Waste Retrieval Annex Areas

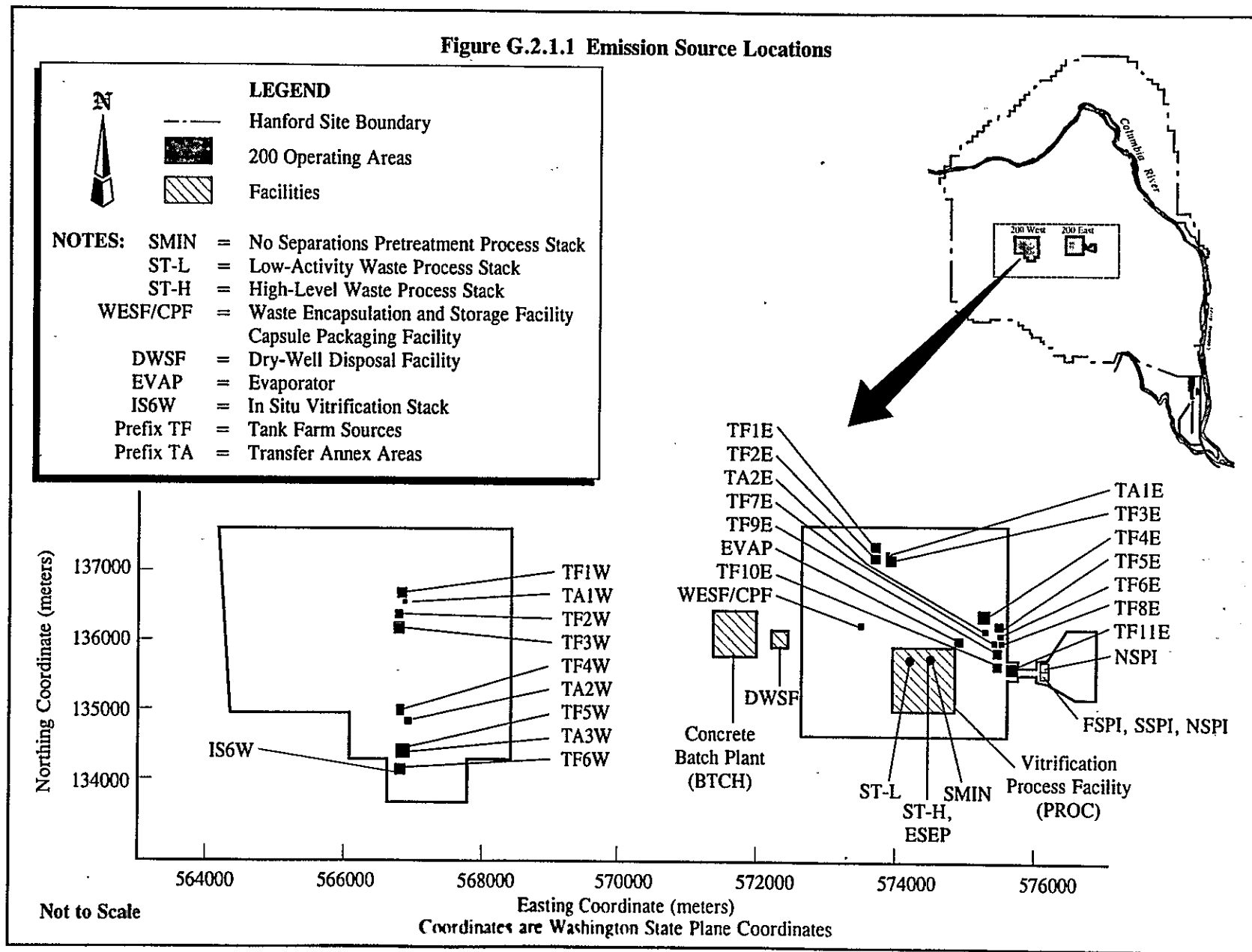
As part of the Ex Situ (Intermediate Separations, No Separations, and Extensive Separations) alternatives, the Ex Situ/In Situ Combination alternative, and the Phased Implementation alternative, waste transfer annexes would be constructed to collect and distribute the waste retrieved from the tanks. Two such facilities (identified as TA1E and TA2E) are expected to be constructed in the 200 East Area, while three facilities (TA1W, TA2W, and TA3W) would be constructed in the 200 West Area. All annexes would be the same size, except the facility identified as TA2W, which would be larger and also serve as a waste sampling facility.

Although no emissions are expected to result from operating these facilities, vehicular emissions and fugitive dust would be produced during their construction. These sources were depicted as area sources in the dispersion models.

Concrete Batch Plant

A concrete batch plant would be constructed to support construction activities. For each model scenario, the batch plant is assumed to have sufficient capacity to support the remediation activities. For the purpose of impact assessment, this batch plant is assumed to be located between the 200 Areas. The emissions from this process were modeled as an area source (identified as BTCH).

Figure G.2.1.1 Emission Source Locations



Process Facilities and Tank Farm Construction

Emissions from constructing the processing facilities related to the Ex Situ and Ex Situ/In Situ Combination alternatives include vehicle exhaust emissions and fugitive dust released during earthmoving operations. A single area source (identified as PROC) centered on and equal in size to the disturbed area (80 hectares [ha] [200 acres (ac)]) expected for constructing the process facilities for the Ex Situ Intermediate Separations alternative was used to model these emissions. Bounding-case construction emissions related to constructing retrieval equipment at the tank farm locations were modeled as an area source at the tank farm designated TF6W.

For the first phase of the Phased Implementation alternative, two processing facilities would be constructed. Emissions associated with this activity include vehicle and heavy equipment exhaust emissions, and fugitive dust releases. A single area source (FCPI), which encompasses the locations of both plants, was used to model these emissions. In addition, particulate matter emissions from the Pit 30 site (BTCH) would occur.

During the second phase of this alternative, large-scale facilities would be constructed to treat the remainder of the tank waste. Emissions would come from constructing the five waste transfer annexes, process facilities, and a concrete batch plant. Emissions from erecting retrieval equipment at the tank farms would occur simultaneously.

Borrow Site Excavation

For the In Situ Fill and Cap alternative, particulate matter emissions would result from the use of heavy equipment to excavate and transport borrow materials from Pit 30, which is located between the 200 East and 200 West Areas at the same location as the concrete batch plant (BTCH).

For all alternatives, except the No Action alternative, excavation of borrow materials from the Vernita Quarry and McGee Ranch would result in similar particulate matter emissions. These emissions would be associated with installing post-closure barriers over the tank farms. Because of a lack of data concerning these operations, specific emissions estimates and modeling were not performed. However, any such operations would include appropriate control measures (such as using surfactants and water spray procedures) that would result in compliance with Federal and State air quality standards.

Process Facilities Operation

Essentially all the emissions during the processing operations for the Ex Situ (Intermediate Separations, No Separations, and Extensive Separations) alternatives and the Ex Situ/In Situ Combination alternative would occur through the main processing facility stacks. The LAW and HLW processing facilities stacks for the Ex Situ Intermediate Separations alternative are designated as ST-L and ST-H, respectively. The Ex Situ No Separations alternative would have one stack, identified as SMIN. Although two plants would operate in the Ex Situ Extensive Separations alternative scenario, emissions from both plants would be routed through a common stack, designated as ESEP. Processing facilities for the Ex Situ/In Situ Combination alternative would be similar to but with less capacity than facilities for the Ex Situ Intermediate Separations alternative. Because stack locations and release parameters are

expected to be similar, these stacks were modeled using sources ST-L and ST-H. All stacks were modeled as point sources.

Emissions from the two vitrification processing facilities that would be constructed for the Phased Implementation alternative would be routed through stacks. The stack for the LAW processing facility was designated as SSPI, while the combined LAW/HLW processing facility stack was designated as NSPI. Both stacks were modeled as point sources.

In Situ Vitrification Process Stacks

During vitrification operations for the In Situ Vitrification alternative, off-gases would be treated and released through one process stack per tank farm. Although two tanks from a single tank farm would be vitrified simultaneously, it is assumed that emissions from both vitrified tanks would be discharged from a single stack. The facility location that would produce the highest impact (in association with the construction emissions) was identified to be at the tank farm location known as TF6W. A point source (identified as IS6W) was used to model emissions from the process stack.

Dry-Well Storage Facility

A Dry-Well Storage Facility would be constructed as part of the Onsite Disposal alternative for the cesium and strontium capsules. The emissions resulting from the construction of this facility are represented as an area source identified as DWSF. No emissions were assumed to result from the operations phase of this alternative.

Capsule Packaging Facility

The capsules Overpack and Ship alternative would involve emissions resulting from constructing and operating a Capsule Packaging Facility (CPF). These emissions are represented by an area source identified as CPF.

Waste Encapsulation and Storage Facility

Routine radiological emissions from the Waste Encapsulation and Storage Facility were analyzed for all alternatives. These emissions would occur through a stack, and were modeled as a point source (WESF).

Evaporator

Operating an evaporator during continued operations and waste processing operations is expected to release radiological and nonradiological components. These emissions would occur through a stack, and were modeled as a point source (EVAP).

W-314 Project

This project potentially involves the replacement of various transfer lines located in the 200 East and West Areas. The data available for this project indicates that construction activities would be spread out over various areas and would be of relatively low intensity compared to construction activities associated with other TWRS alternatives. In addition, dust-control measures would be employed that

would minimize emissions from these activities. Because substantial emissions are not anticipated, the emissions from the W-314 Project were not separately analyzed.

G.2.2 MODEL SCENARIOS

The various alternatives would involve emissions from one or several of the sources described previously. Implementing alternatives would involve an initial phase of facility construction followed by a phase during which the treatment, transfer, or repackaging processes would occur. Consequently, each alternative may have different phases where the emissions and analyzed impacts are distinctly different. Therefore, the emissions and analyzed impacts resulting from each phase were calculated and are reported separately for each alternative. The following sections discuss each proposed TWRS EIS alternative and describe the associated emissions sources.

G.2.2.1 Tank Waste Alternatives

No Action Alternative (Tank Waste)

The No Action alternative would involve routine radiological and nonradiological emissions from continued operation of the storage tanks, and continued operation of the evaporator as a waste management activity. In addition, routine radiological releases from WESF would occur and are considered. No construction activities would be associated with this alternative.

The emissions from the continued operations of tank farms would also occur during the construction and operation phases of the alternatives, and are included in the analysis of these alternatives.

Long-Term Management Alternative

The Long-Term Management alternative involves two phases having air emissions, each of which was analyzed separately. The first phase would involve transferring waste from existing DSTs to newly constructed DSTs 50 years in the future. Waste from the SSTs would not be retanked. The new tanks would be constructed in the same area as the process facility that would be built for the Ex Situ Intermediate Separations, Ex Situ No Separations, and Ex Situ Extensive Separations alternatives; the construction emissions were modeled by assigning them to the location PROC. In addition, continued tank and evaporator emissions would occur simultaneously at the tank farms and the evaporator locations. Increased emissions are expected from tanks undergoing retrieval. These increased emissions were modeled by assigning the highest increased emission rate for each pollutant to the TF6W Tank Farm, which was identified as the tank farm location producing the highest impacts. The actual emissions for every chemical are not necessarily the highest at TF6W.

The emissions from the tank farms during retrieval operations would be the same as would be expected for retrieval activities associated with the operational phases of the Ex Situ (Intermediate Separations, No Separations, and Extensive Separations) alternatives. These impacts have been included with the analysis of these alternatives.

The second phase (replacement of the tanks 100 years in the future) is similar to the first phase, except that the routine and increased tank emissions would occur within the PROC area, as well as the construction emissions.

In Situ Fill and Cap Alternative

Implementing this alternative would involve construction and gravel-filling operations at the tank farm locations, as well as gravel removal from Pit 30.

For the purposes of the analysis, construction activities are assumed to occur simultaneously with the filling operations and routine emissions from the continued operation of the tank farms. The following text summarizes the pollutant emitting activities and sources for this alternative:

- Particulate matter emissions are expected as a result of gravel handling operations at Pit 30 (BTCH).
- Construction equipment emissions are expected at the tank farm location. To provide a conservative approach, emissions from construction activities were assigned to the bounding-case location (TF6W).
- Gravel handling operations are assumed to occur at a location central to several tank farms: the corresponding emissions were assigned to location TF5W.
- Increased tank emissions during filling operations are expected. To ensure a conservative approach, the increased tank emissions were assigned to location TF6W in a similar manner as was done for retrieval operations.

The emissions from the tank farms during gravel filling operations would be the same as would be expected during the in situ portion of the Ex Situ/In Situ Combination alternative and have been included in the analysis of that alternative.

In Situ Vitrification Alternative

Implementing this alternative would involve constructing a tank farm confinement facility and an off-gas treatment facility at each tank farm. Construction of one confinement facility would occur while vitrification processes were occurring at an adjacent tank farm. For potential air quality impacts, the bounding-case location for construction was identified as TF6W, and the impacts described are for this bounding-case scenario.

Operations associated with this alternative would release pollutants that would be treated in an off-gas treatment facility. The emissions from the off-gas treatment facility would be from a vertical stack. The bounding-case location for this operation was shown to be adjacent to TF6W. Although construction and operations activities would not occur at the same time and at the same tank farm location, the operational emissions were assigned to this location (IS6W) to provide a bounding-case analysis.

Ex Situ Intermediate Separations Alternative

The construction phase would involve vehicular and fugitive dust emissions from constructing five waste transfer annexes and two waste processing facilities and constructing and operating a concrete batch plant to support these operations. Additionally, vehicular emissions associated with constructing tank waste retrieval equipment at the tank farms would occur during this time.

According to the estimated construction schedule, work would not be expected to occur at more than two tank farms at a time. An analysis was conducted to determine the two locations that would produce the highest impact when construction activities occurred simultaneously. It identified the TF5W and TF6W areas as having the highest combined impacts. Accordingly, the impacts of these activities were analyzed by assuming simultaneous construction operations at:

- The process facility locations;
- The concrete batch plant;
- The five transfer annex areas (TA1W, TA2W, TA3W, TA1E, TA2E); and
- Two tank farm locations (TF5W and TF6W).

The operational phase of the Ex Situ Intermediate Separations alternative would involve separating the waste into HLW and LAW streams and processing the waste at separate facilities. HLW vitrification processing would occur over a 12-year period while LAW processing would occur over a 19-year period. Additionally, retrieval equipment would operate at no more than two tank farm locations at a time during the course of the processing. Therefore, the impacts of the operations phase of the alternative were calculated by evaluating the simultaneous operation of both processing facilities (ST-L and ST-H) and the two tank farm locations (i.e., TF5W and TF6W) producing the highest impacts.

Ex Situ No Separations Alternative

The emission scenario for the Ex Situ No Separations alternative differs from the Ex Situ Intermediate Separations alternative because the tank waste would not be separated into LAW and HLW components and only one processing plant with one process stack (as opposed to two) would be operated. Two options (vitrification and calcination) were analyzed for this alternative. The sources and emission rates associated with the calcination option are identical to those of the vitrification alternative, with the exception of the emission rates of nitrogen oxides and carbon-14 (Jacobs 1996).

The construction phase would involve vehicular and fugitive dust emissions from constructing the five waste transfer annexes and the process facilities, and from constructing and operating a concrete batch plant to support these operations. Additionally, vehicular emissions from erecting the retrieval equipment at the tank farms would occur during this time. These emissions were assigned in the same manner as described for the Ex Situ Intermediate Separations alternative construction phase, although emission rates differ.

Operational processes for the Ex Situ No Separations alternative would occur over a 14-year period, beginning after completion of the construction phase. Emissions would occur through the main process stack at the vitrification facility. Additionally, installing and operating retrieval equipment would occur

at only two tank farm locations at a time during processing. Therefore, the impacts of the operations phase of the alternative were calculated by evaluating the simultaneous operation of the process facility and the two tank farm locations (i.e., TF5W and TF6W) producing the highest combined impacts.

Ex Situ Extensive Separations Alternative

The construction phase would involve vehicular and fugitive dust emissions from constructing the five waste transfer annexes and the process facilities, and from constructing and operating a concrete batch plant to support these operations. Additionally, vehicular emissions from erecting the retrieval equipment at the tank farms would occur during this time. These emissions were assigned in the same manner as described for the Ex Situ Intermediate Separations alternative construction phase, although emission rates differ.

The operational phase of this alternative would involve separating the tank waste into HLW and LAW streams and processing the waste at separate facilities. HLW and LAW processing vitrification processing would occur over a 21-year period. The off-gas emissions from these two processes would be combined and routed through a common stack (ESEP). In addition, retrieval equipment would be operated at only two tank farm locations at a time during processing. Therefore, the impacts of the operations phase of the alternative were calculated by evaluating the simultaneous operation of the process facilities (ESEP) and the two tank farm locations (i.e., TF5W and TF6W) producing the highest combined impacts.

Ex Situ/In Situ Combination Alternative

Implementing the in situ portion of this alternative would involve the same source locations and emissions scenarios as described for the In Situ Fill and Cap alternative, although lower emission rates are expected. These emissions will occur simultaneously with those associated with the operational phase of the ex situ portion of the alternative.

The construction phase would involve vehicular and fugitive dust emissions from constructing the five waste transfer annexes and the process facilities, and from constructing and operating a concrete batch plant to support these operations. Additionally, vehicular emissions from erecting the retrieval equipment at the tank farms would occur during this time. These emissions were assigned in the same manner as described for the Ex Situ Intermediate Separations alternative construction phase, although emission rates differ.

The operational phase of the ex situ vitrification portion of the alternative would involve separating the HLW and LAW streams and processing the waste at separate facilities. HLW vitrification processing would be expected to occur over a 24-year period, while LAW processing would be expected to occur over a 19-year period. Additionally, retrieval equipment would be expected to operate at no more than two tank farm locations at a time during processing. Therefore, the impacts of the operational phase of this alternative were calculated by evaluating the simultaneous operation of both process facilities (ST-L and ST-H) and the two tank farm locations (i.e., TF5W and TF6W) producing the highest impacts.

Phased Implementation Alternative**Phase 1**

Implementation of the first phase of this alternative would involve a construction period, during which two vitrification facilities would be constructed. Because construction on both facilities would occur simultaneously, the construction emissions were assigned to a single area source (FCPI) that encompasses the expected disturbed area.

Following completion of construction, operation of the two facilities would commence. Emissions from the vitrification processes would be released through two stacks -- one located at the combined LAW/HLW facility (NSPI), and one located at the LAW facility (SSPI). LAW operations at both plants would occur over a 10-year period; HLW operations at the combined plant would occur for 6 years. The impacts from these activities were calculated by using the peak hourly emission rates from all processes simultaneously.

Phase 2

In the second phase of this alternative, large-scale facilities would be constructed to treat the remainder of the tank waste. Emissions would come from constructing the five waste transfer annexes (TA1W, TA2W, TA3W, TA1E, TA2E), process facilities, and a concrete batch plant (BTCH). Emissions from erecting retrieval equipment at the tank farms producing the highest impacts (TF5W, TF6W) would occur simultaneously. These emissions were assessed in the same manner as described for the Ex Situ Intermediate Separations alternative.

Total Alternative

Impacts from the operation of the total Phased Implementation alternative are analyzed in the same manner as for the Ex Situ Intermediate Separations alternative. This involves the simultaneous operation of the two facilities discussed under Phase 1 (NSPI and SSPI), the large-scale facilities (ST-L and ST-H), and the two tank farm locations producing the highest impacts (TF5W and TF6W).

G.2.2.2 Cesium and Strontium Capsule Alternatives**No Action Alternative (Capsules)**

This alternative would involve maintaining the capsules at WESF. Routine radiological emissions from WESF were analyzed for this alternative and were included in the analysis of all other alternatives. These emissions were modeled as a point source (WESF). No other impacts are expected from this alternative.

Onsite Disposal Alternative

This alternative would involve transferring the existing capsules to a newly constructed Dry-Well Storage Facility. Constructing the Dry-Well Storage Facility would result in emissions from construction. These construction emissions were assigned to the source identified as DWSF. There would be no emissions during operations for this alternative. No airborne emissions are anticipated from the sealed cesium and strontium capsules while they are in storage. The only operational activities would be facility monitoring.

Overpack and Ship Alternative

This alternative would involve recovering the capsules from WESF, repackaging them, and shipping them to the potential geologic repository. A repackaging facility would be built as part of this alternative. Construction emissions and minor operational emissions would occur. These emissions were assigned to the area source identified as CPF.

Vitrify with Tank Waste Alternative

This alternative would involve recovering the cesium and strontium capsules from WESF, removing the contents, and vitrifying the capsule contents along with tank waste. Because the emissions occurring under this alternative are combined with emissions from remediating tank waste, no separate air quality impacts were analyzed.

G.3.0 MODEL SELECTION AND METHODOLOGY

Version two of the U.S. Environmental Protection Agency (EPA) Industrial Source Complex Model (ISC2) was selected to perform the air-dispersion modeling (EPA 1992a). The ISC2 model is a Gaussian dispersion model capable of simulating emissions from diverse source types. In a Gaussian dispersion model, pollutant concentrations are assumed to be distributed normally (i.e., bell-shaped curve) about the centerline of the plume, a relationship that has been observed to occur for releases of gases and small particles from many types of sources. ISC2 is a guideline air quality model (i.e., it is accepted by EPA for regulatory applications [40 CFR Part 51]). It is also routinely recommended for performing screening and refined analyses for remedial actions at Resource Conservation and Recovery Act and Superfund sites (EPA 1989a). This model was selected based on its widespread acceptability and versatility.

ISC2 consists of two models; a short-term version (ISCST2) appropriate for predicting concentrations averages of 1 to 24 hours, and a long-term version (ISCLT2) for predicting seasonal and yearly concentrations. Both models were incorporated in this study. ISCLT2 was used to generate annual average predicted concentrations for comparison with annual average ambient air quality standards and target levels. ISCST2 was executed in a screening mode to predict short-term ambient air concentrations for comparisons to 1 to 24 hour average air quality standards and other target levels (EPA 1992b).

G.3.1 MODEL OPTIONS AND INPUTS

ISC2 requires the input of source and meteorological data as well as receptor coordinates (i.e., locations for which the model computes a concentration). The model must also be configured properly by the selection of various options. The following discussions document the inputs and model configuration.

G.3.1.1 Model Options

The models were run using the standard rural dispersion coefficients. These are selected based on the nature of the land use in the vicinity of the emission sources. Standard EPA procedures were followed in making this determination (40 CFR Part 51).

The regulatory default option was selected, which implements the following model options:

- Final plume rise;
- Buoyancy-induced dispersion;
- Default wind profile exponents;
- Default vertical potential temperature gradients; and
- Upper bound values for supersquat buildings.

G.3.1.2 Source Data

The manner in which sources were grouped for each alternative is discussed in Section G.2.2. Source-related model input data are shown on Table G.3.1.1. Please note that all tables are located at the end of Appendix G. The chemical pollutant emission rates for each phase of the alternatives are shown in Tables G.3.1.2 through G.3.1.18. Tables G.3.1.19 through G.3.1.29 contain the radiological emission rates. When appropriate, construction and operational emissions from the alternatives were analyzed separately, and separate emissions data for construction and operational activities are reported. In other cases, construction and operational processes would occur simultaneously, and the emission rates reported represent the combined emissions from construction and operational activities.

The primary sources of data used for the emission rates were the engineering data packages for the various alternatives, which were prepared by the Hanford Site maintenance and operations contractor (WHC 1995 a, b, c, d, e, f, g, h, i, n) and the TWRs EIS contractor (Jacobs 1996). The following discussion describes the protocol used for calculating model emission rates from the available data.

Routine Emissions from Tank Farms and the Waste Encapsulation and Storage Facility

Routine emissions of radiological and nonradiological components from continued operations of the tank farms and WESF are shown for the No Action alternative (Tank Waste) in Tables G.3.1.2 and G.3.1.19. Emissions are reported separately for each tank farm location (Jacobs 1996). Similar emissions are expected to occur and were analyzed for all alternatives. However, during retrieval operations (and during gravel filling operations associated with the In Situ Fill and Cap alternative), the routine emissions rates are expected to increase at the affected tank farm location. In these situations, the increased emission rates were analyzed in the following manner; the highest routine emission rate for each pollutant was assigned to source TF6W to provide a bounding-case scenario, and increased by the appropriate factor to represent retrieval or gravel filling operations.

In Situ Vitrification Emission Data

Data contained in the engineering data packages for this alternative were analyzed to generate tables of radiological and nonradiological emissions for this alternative (Jacobs 1996). Separate emissions data for the construction and operational phases for the alternative were created. Annual construction emissions were converted to peak hourly emissions based on an assumed schedule of construction activities. The peak hourly emission rate of each pollutant for the vitrification process was used for the model input.

Process Facility Stack Emissions Data

Process flow diagrams and mass balance data contained in the engineering data packages were analyzed to generate tables of average annual emissions, maximum daily emissions, and peak hourly emissions from the vitrification facility process stacks for the Ex Situ Intermediate Separations, Ex Situ No Separations, and Ex Situ Extensive Separations alternatives, including the Ex Situ/In Situ Combination and the Phased Implementation alternatives (Jacobs 1996). The peak hourly emissions for pollutants listed in these tables were used to generate emission rates for the process stacks.

Construction Activities Emission Data

The primary sources of construction activity emission data were the engineering data packages for the various alternatives. In some cases, data concerning the construction emissions were not given explicitly in the data package. Calculations were performed to estimate the emissions given the scope of the construction activity (Jacobs 1996). Annual emissions were converted to hourly emissions based on an assumed schedule for construction activities.

G.3.1.3 Meteorological Data

Long-Term Meteorological Data

The meteorological data used for the ISCLT2 model consisted of a joint frequency distribution, also referred to as a stability array (STAR) of wind speed, wind direction, and stability class compiled for each of 5 years (1989 to 1993). The stability arrays are shown in Tables G.3.1.31 through G.3.1.35. These data were based on measurements collected at the Hanford Meteorological Station located between the 200 East Area and 200 West Area (PNL 1994g). The general wind direction is to the southeast.

Additional meteorological data, such as the annual mean temperature and mixing heights, were obtained from the Hanford Climatological Data Summary (PNL 1994g) and a standard summary document of morning and afternoon mixing heights (Holzworth 1972). The protocol for assigning these values was taken from the ISC2 User's Manual (EPA 1992a). As outlined in the user's manual, the average annual maximum daily temperature (18 °C [65 °F]) was used for the A, B, and C stability classes; the average minimum daily temperature (5 °C [42 °F]) was used for the stability classes E and F; and the average annual temperature (12 °C [53 °F]) was used for the D stability class. Mixing height values were assigned as follows: 1.5 times the average afternoon mixing height of 1,500 m (4,900 ft) was used for stability class A and the average afternoon mixing height was used for stability classes B, C, and D. Because ISCLT2 in the rural mode assumes that there is no restriction in vertical mixing in the E and F stability classes, 1.5 times the average afternoon mixing height was considered to be appropriate for these stability classes.

Short-Term Meteorological Data

ISCST2 requires hourly meteorological data. Typically, for refined and regulatory modeling, a full year of sequential hourly records are input to the model. Because data in this format for the Hanford Site were unavailable and a refined level of modeling was not considered necessary given the preliminary nature of the design data, the ISCST2 model was executed in a screening mode. This

required inputting a range of possible meteorological conditions which might reasonably occur at this site. This screening meteorological file was prepared according to procedures outlined in EPA's SCREEN2 Model User's Guide (EPA 1992c).

For each of 36 wind directions, 54 possible combinations of stability class and wind speed were input (i.e., 1,944 hourly records). A matrix of windspeed and stability classes is shown in Table G.3.1.30.

Atmospheric mixing heights were assigned to stability classes A, B, C, and D using the mechanical mixing height (Z_m) and calculated using the following formula taken from Section 3.2 of the SCREEN2 Model User's Guide:

$$Z_m = 320 \cdot u_{10}$$

Where: Z_m = mechanical mixing height (m)

u_{10} = wind speed at 10 m elevation (m/s)

To allow for unlimited mixing, heights of 10,000 m (32,800 ft) were assigned to stability classes E and F, in keeping with the scheme outlined in the SCREEN2 User's Manual. Ambient temperatures for each stability class were assigned in the same manner as the ISCLT2 model inputs.

G.3.1.4 Receptor Locations

Three receptor sets were used for the study. The first set was used to predict concentrations for comparison with Washington State and Federal ambient air quality standards and target levels for nonradionuclide impacts, and for comparison with the Washington State ambient air quality standard for radionuclides. These receptor locations were placed to correspond to areas that might be considered to be ambient air (i.e., areas where the general public could be exposed). Because of the potential release of the Fitzner Eberhardt Arid Lands Ecology portion of the Hanford Site, the public would have access to land southwest of State Route 240, and it was selected to represent the southern boundary of the facility. For the same reason, the Columbia River was selected to define the northern and eastern facility boundaries. A total of 614 receptors were placed along the Columbia River, State Route 240, and the Hanford Site boundary line north of the Columbia River. Because of the size of the Hanford Site, most offsite receptors are quite distant from the sources and were placed with a 2-km (1.2-mi) spacing. To ensure that the areas of maximum impact were identified, receptors were placed at 500-m (1,650-ft) intervals along sections of State Route 240 to ensure adequate coverage.

The second set of receptors was used to assess compliance with the Federal standard for radionuclide release impacts contained in 40 CFR Part 61. Compliance with this standard is calculated at the nearest residence, rather than at the nearest ambient air location. Although the distance from the source locations to the nearest residence in all directions is not known, available data indicates that no residence lies within 24 kilometers (km) (15 mi) of the 200 West area, or 16 km (10 mi) of the 200 East Area (DOE 1994d). Thus, a circular set of 72 receptors, centered on the 200 West Area and

with a radius of 24 km (15 mi), was established to assess compliance with this standard. This circular grid encompasses all locations within 16 km (10 mi) of the 200 East Area.

A rectangular grid of 834 receptors, which encompasses the entire Hanford Site, was used to generate isopleths of radionuclide impacts.

ISC2 is designed to model simple terrain (i.e., terrain less than or equal to stack height). Terrain elevation is relevant for modeling point sources. Concentration predictions from area source emissions are not affected by terrain. Elevations for all receptor locations were obtained from a Geographic Information System (GIS) database of the Hanford Site and U.S. Geological Survey topographical maps of the surrounding area.

G.3.2 MODEL OUTPUT

The model output consisted of ground level average concentration values. ISCLT2 produced annual average concentrations for each of the 5 years (1989 to 1993) of meteorological input data. The predicted concentrations reported are from the year producing the highest impact. ISCST2 was executed to determine the maximum 1-hour average concentrations resulting from inputting a range of possible meteorological conditions. The 1-hour averages were multiplied by various correction factors for predictions of 3-, 8-, and 24-hour average concentrations. The following sections provide more details on the concentration calculations.

G.3.2.1 Normalized Concentrations

To provide efficiency in processing the results and flexibility for incorporating future changes, the sources were modeled with unit emission rates, resulting in predictions of normalized concentrations (also referred to as X/Q values).

The normalized concentrations, having dimensions of 1.0E-06 seconds/cubic meter (s/m³), were produced by assigning each source a unit emission rate of 1.0 grams per second (g/s). The concentration at a receptor was calculated by multiplying the actual emission rate (referred to as the source term) by the appropriate X/Q value. For example, a source term expressed in units of g/s will produce a concentration given as $\mu\text{g}/\text{m}^3$, and a source term expressed in units of curies per second (Ci/s) will produce a concentration given as $\mu\text{Ci}/\text{m}^3$.

The total concentration at any receptor consists of the sum of the concentrations contributed by each emitting source. Therefore, the total concentration at a receptor with n contributing sources is calculated as follows:

$$C_{\text{total}} = (X/Q)_1 \cdot T_1 + (X/Q)_2 \cdot T_2 + \dots + (X/Q)_n \cdot T_n$$

Where:

C_{total}	= total concentration ($\mu\text{g}/\text{m}^3$ or $\mu\text{Ci}/\text{m}^3$)
$(X/Q)_n$	= predicted X/Q value ($1.0\text{E-}06 \text{ s}/\text{m}^3$) for source n
T	= source term (g/s or Ci/s) for source n

Separate X/Q plot files were generated for each of the 30 identified sources. To calculate the total concentration values these plot files have been entered into spreadsheets. These spreadsheets allow the input of source terms of interest for each pollutant and the calculation of total concentration values at each receptor location.

G.3.2.2 Averaging Time Conversions

Values for 3-, 8-, and 24-hour averages were obtained by multiplying the calculated 1-hour average concentration by the following conversion factor: 0.9 for 3-hour averages, 0.7 for 8-hour averages, and 0.4 for 24-hour averages (EPA 1992b).

G.4.0 MODEL RESULTS

The results of the modeling were compared with Washington State air quality standard or acceptable source impact levels. Washington State standards are listed in the Washington Administrative Code (WAC) and include:

- Acceptable Source Impact Levels for toxic air pollutants (WAC 173-460);
- Ambient Air Quality Standards for particulate matter (WAC 173-470);
- The Ambient Air Quality Standards for sulfur oxides (WAC 173-474);
- The Ambient Air Quality Standards for carbon monoxide ozone and nitrogen dioxide (WAC 173-474);
- The Ambient Air Quality Standards for radionuclides (WAC 173-480); and
- The Ambient Air Quality Standards for fluorides (WAC 173-481).

The results were also compared with national primary and secondary Ambient Air Quality Standards listed in 40 CFR Part 50. The Washington Ambient Air Quality Standards are equal to or are more stringent than the National Ambient Air Quality Standards, and thus compliance with the Washington Ambient Air Quality Standards implies compliance with the National Ambient Air Quality Standards.

Predicted maximum emissions for hazardous air pollutants and pollutants for which a Washington Acceptable Source Impact Level exists are provided along with the applicable level. Modeling results for chemical pollutants are given in Tables G.4.0.1 through G.4.0.19. Modeled impacts for key radionuclides during operations are plotted in Figures G.4.0.1 through G.4.0.11 and presented for each alternative in Tables G.4.0.20 through G.4.0.30. The modeling results show radionuclide emissions converted to doses and compares them to Washington Air Quality Standards for radiation doses contained in WAC 173-480 and Federal standards for radioactive emissions from DOE facilities (40 CFR 61, Subpart H). Uranium-235 (U-235) was not included in the impacts for radionuclides. Uranium trioxide was, however, analyzed as a hazardous air pollutant. This approach is consistent with the risk analysis for routine operations for each alternative, because the chemical toxicity of

uranium is much greater than its radiological hazard. Additionally, emissions of U-235 were determined to have a very small contribution to overall risk.

The modeling results for all alternatives show no exceedances of Federal or State air quality standards for criteria pollutants, hazardous air pollutants, or radionuclides. Substantial impacts from all sources (those that exceed 10 percent of the applicable standard) are listed in the following text:

PM-10	Substantial impacts, as a percentage of the Federal and State 24-hour standard, occur during the construction phases of the In Situ Vitrification alternative (64 percent of the standard) and the construction phases of the Ex Situ Extensive Separations, Ex Situ Intermediate Separations, and Ex Situ No Separations) alternatives (63 percent, 62 percent, and 57 percent, respectively). In addition, substantial impacts occur during the construction phases of the Ex Situ/In Situ Combination alternative (34 percent of the 24-hour State and Federal standards), the Phased Implementation alternative (58 percent of the State and Federal 24-hour standard), and the Capsules Onsite Disposal alternative (12 percent of the State and Federal 24-hour standard).
CO	Substantial impacts, as a percentage of the Federal and State 8-hour standard, occur during the construction phases of the Ex Situ Extensive Separations, Ex Situ Intermediate Separations, and Ex Situ No Separations alternatives (25 percent, 21 percent, and 17 percent, respectively).
Sulfur Oxides	Substantial impacts, as a percentage of the State 1-hour standard, occur during the In Situ Vitrification alternative (10 percent of the standard).
Radionuclides	Substantial impacts, as a percentage of the State annual standard, occur during In Situ Vitrification (75 percent of standard, with primary contributors being C-14 and I-129). Substantial impacts, as a percentage of the Federal annual standard, occur during In Situ Vitrification (24 percent of standard, with primary contributors being C-14 and I-129).

G.5.0 ACCURACY AND UNCERTAINTY

Various assumptions and other factors can introduce uncertainty in air dispersion modeling studies. With regard to the modeling performed to analyze air impacts from the various EIS alternatives, these uncertainties can be broadly separated into the following categories:

- Uncertainty inherent in the air dispersion models;
- Uncertainty in data used as model inputs; and
- Uncertainty in interpretation of model output.

These categories are discussed in more detail in the following text.

G.5.1 AIR DISPERSION MODELING

Air dispersion models are mathematical tools designed to estimate pollutant concentration and/or deposition at specific locations. These predictions are based on various input parameters and physical assumptions, such as the following:

- Pollutant release characteristics (emission rate, temperature, flow rate);
- Meteorological conditions (ambient temperature, mixing height, stability, wind speed and direction, atmospheric temperature and wind speed profile); and
- Pollutant transport behavior (dispersion, plume rise, interaction with terrain).

In an ideal case, the values entered into the model for these known parameters will closely duplicate the range of actual conditions that exist for a particular scenario. However, the stochastic nature of the atmosphere results in other unknown factors (e.g., wind perturbations) that influence the actual dispersion at a particular time or place. It has been estimated that even when the known conditions are exactly duplicated in the model, the unknown factors can contribute to variations in concentration as much as ± 50 percent (EPA 1995).

Gaussian air dispersion models are accurate within a factor of two when properly executed with accurate data. In general, models are more reliable when estimating long-term average concentrations as opposed to short-term averages, and are reasonably reliable in estimating the magnitude of the highest concentration occurring, but are not capable of predicting the exact time or position of the occurrence. In other words, the highest concentration that can be expected in an area can be predicted with reasonable accuracy; the location and time that the maximum concentration will occur are less reliably predicted.

The air dispersion models used in this study are considered to be state-of-the-art for regulatory modeling and are recommended by EPA for this type of analysis. To compensate for the uncertainties in model results, conservative input values were used that provide conservative (higher than might actually occur under average conditions) results.

G.5.2 MODEL INPUT DATA

Two types of input data are used for the air dispersion models: meteorological data and source data. Both types of input data are discussed in the following text.

G.5.2.1 Meteorological Data

Two types of meteorological data (i.e., long-term and short-term) were used in the dispersion modeling study. Long-term (i.e., annual) average concentrations were estimated using meteorological data collected at the Hanford Meteorological Station from 1989 to 1993. The assumption inherent in this choice is that this data represents future meteorological conditions. A 5-year record is generally accepted as an adequate sample set for modeling purposes. Although long-term climatic shifts may occur, many of the air pollutant emitting activities analyzed in this study are expected to occur within

several decades of project initiation, which is a relatively short time frame on a climatic scale. Therefore, the use of this data is not expected to adversely affect the results.

Typically, short-term average (i.e., 1- 3- 8- and 24-hour) concentrations are predicted using hourly meteorological measurements from a station located at, or near, the site of interest. Because the data was not available for this study, a screening approach was taken, and a standard set of hourly meteorological conditions were incorporated in the modeling. These standard conditions are accepted by the EPA to encompass the range of atmospheric stabilities and wind speeds that could be expected to occur anywhere. Each combination of wind speed and atmospheric stability was assumed to occur in every possible wind direction. The predicted concentrations represent the highest value that could be reasonably expected to occur anywhere. This approach is conservative because the meteorological condition leading to the reported result may not occur at the site for all wind directions.

G.5.2.2 Source Data

Data describing the location, emission rate, and emission characteristics of the sources is input to the models. Information concerning pollutant emission rates was derived from data packages supplied by the Site maintenance and operations contractor and analyzed by the EIS contractor. In general, when emissions estimates were being developed, conservative values were used.

The location of the pollutant emitting sources is not known with complete certainty in all cases. Pollutant emitting activities associated with the existing tank farms will occur in the present locations. However, the exact location of future facilities is subject to some uncertainty. In general, the closer a source is to a receptor, the higher the predicted concentration at that receptor will be. As a consequence, if the eventual location of an emitting activity is closer to a plant boundary than depicted in the model, the impacts may be higher. Of course, if the activity is located farther from the boundary than depicted in the model, the impacts may be lower.

The temporal arrangement of the pollutant emitting activities affects the predicted concentrations as well. The predicted concentration at any receptor represents the contributions of each individual emitting source. To properly analyze a scenario, all the pollutant emitting activities that could occur at the same time must be considered. In general, most of the scenarios analyzed involved a period of facility construction followed by an operational period.

In some cases, the location of an emitting source is expected to move from place to place as the project progresses. An example of this would be emissions related to remedial activities at tank farm locations. In most cases, work would be occurring at one or two of the possible 17 locations at one time. Given these uncertainties, a conservative analysis was produced by assuming that activities that may or may not overlap in time occur simultaneously. In addition, activities that are expected to move from place to place were modeled as if occurring in the location producing the highest potential impact.

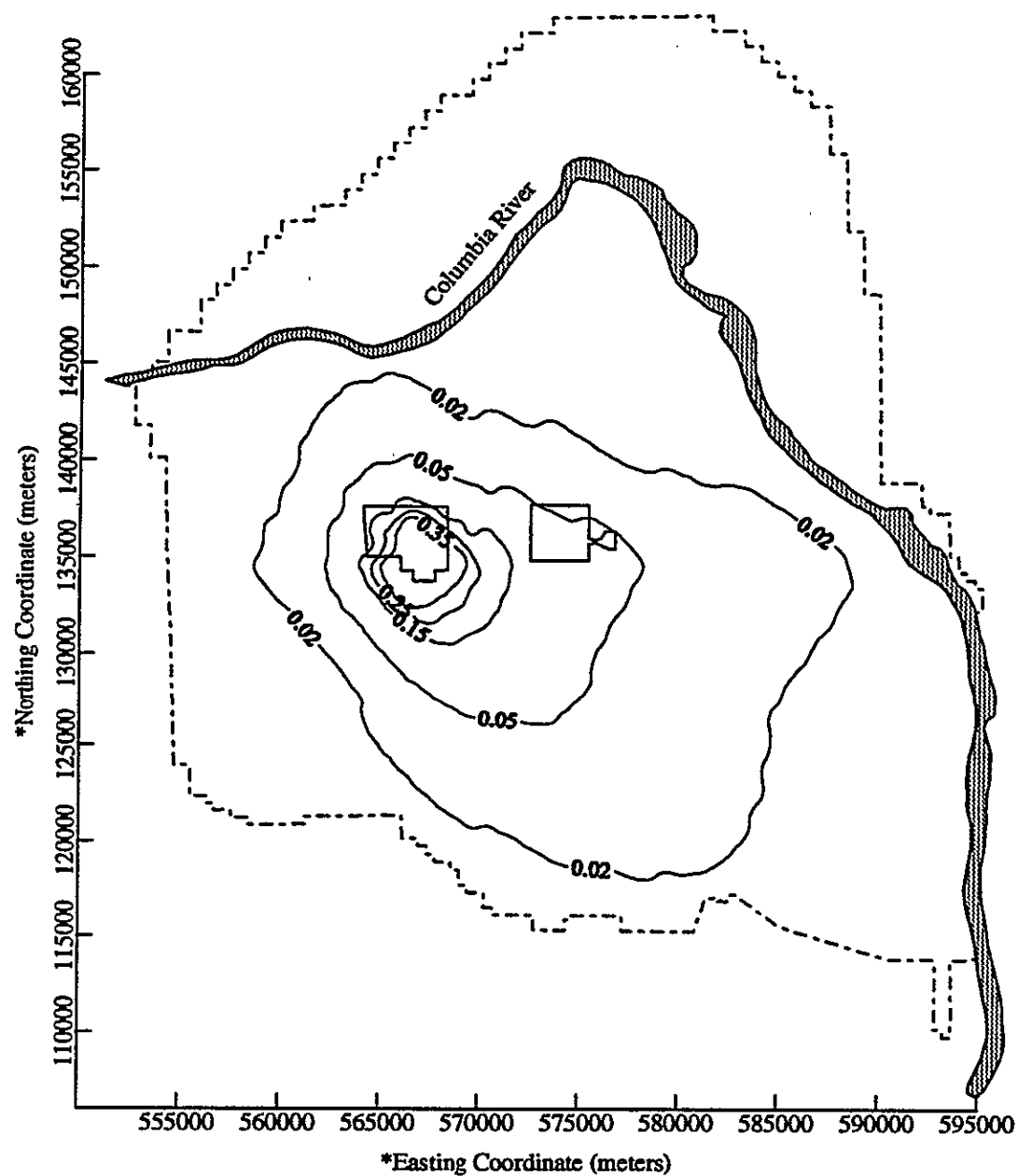
Sources were modeled as either point or area sources. Point sources are used to approximate pollutant releases from a stack or other fixed, functional opening or vent. The dispersion algorithms used for

point sources modify the effective release height to take into account plume buoyancy (from a heated release) and momentum (from vertical release velocity). Typically, area sources are used to approximate pollutant releases that do not occur at a single well-defined point, but instead can be defined as occurring within a defined area. For instance, an area source could include many small fixed point sources that were too numerous to model individually, or could be made up of several mobile sources that may move about within the fixed area. In this study, the construction activities were represented as area sources. The classification of the sources into these two categories involved some degree of uncertainty and some assumptions as well. The models use different algorithms to represent dispersion from point and area sources and the predicted concentration at a receptor could vary, depending on the algorithm chosen. In general, these effects are more noticeable at locations close to the source and tend to diminish as the distance between source and receptor increases.

G.5.3 INTERPRETATION OF MODEL OUTPUT

The short-term model was run using screening meteorology to produce maximum predicted 1-hour average concentrations. These 1-hour average values were converted to 3-, 8-, and 24-hour average concentrations, when appropriate, to compare to applicable standards. This was accomplished by applying conversion factors to the 1-hour average values. Consistent with modeling guidelines (EPA 1988), the factors of 0.9, 0.7, and 0.4 were applied to convert to 3-, 8-, and 24-hour averages, respectively. These factors involve an implied assumption regarding the persistence of the meteorological condition producing the highest 1-hour impact. In other words, conservative meteorological condition that produced the highest 1-hour concentration can be expected to persist for most of a 3-hour period and to a lesser degree over an 8- or 24-hour period. The modeling guidelines indicate a range of values for each conversion factor: the 3-hour conversion factor can range from 0.8 to 1.0, the 8-hour factor from 0.5 to 0.9, and the 24-hour factor from 0.2 to 0.6. Use of the midpoint values was considered appropriate for this study.

Figure G.4.0.1 Radionuclide Dose (mrem/yr) for the No Action Alternative



LEGEND

Minimum Contour .02 mrem/yr.
Maximum Contour .35 mrem/yr.



Columbia River



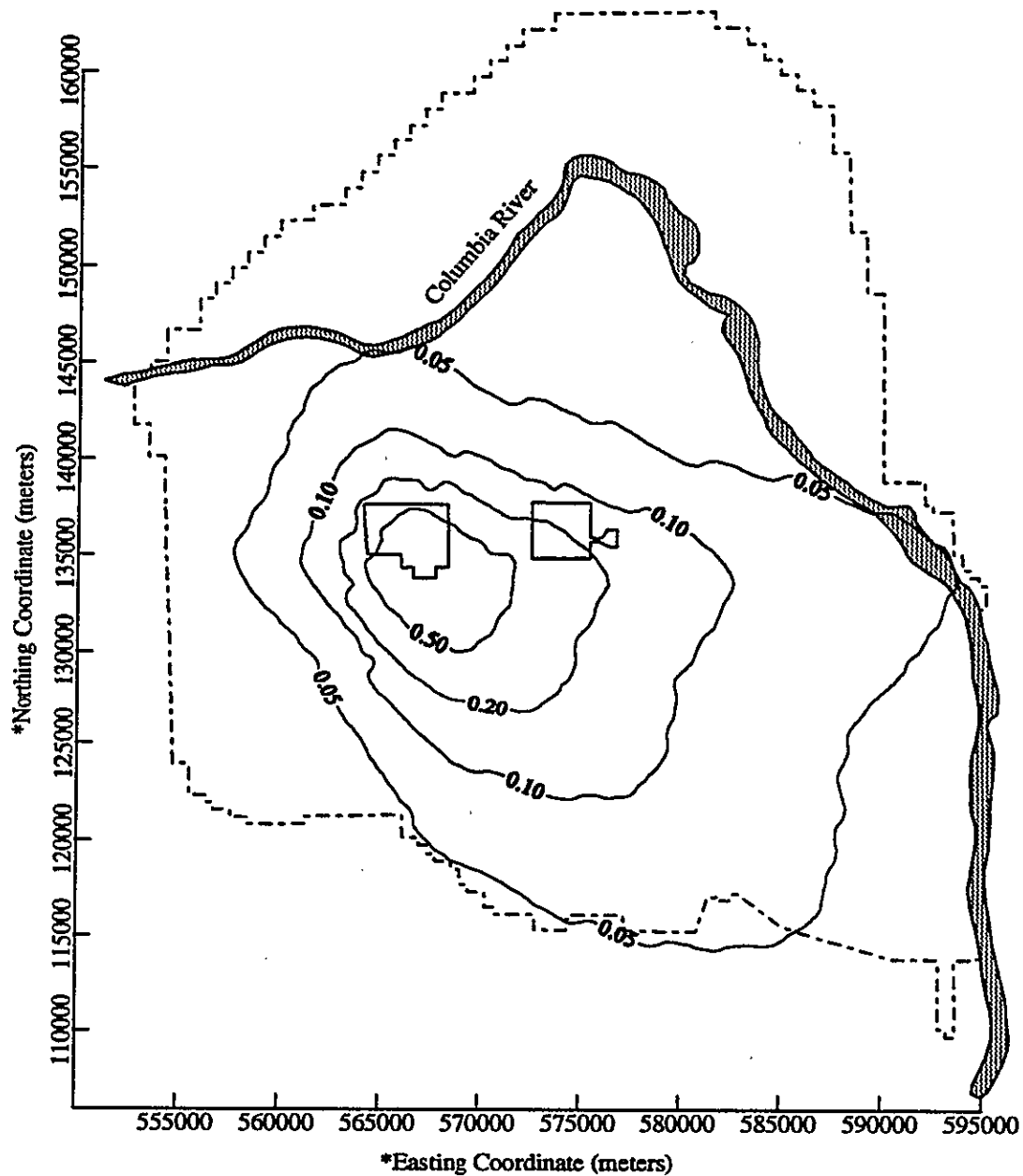
Hanford Site Boundary



200 East and West Operating Areas

* Washington State Plane Coordinates

Figure G.4.0.2 Radionuclide Dose (mrem/yr) for the Long-Term Management Alternative (Phase 1)



LEGEND

Minimum Contour .05 mrem/yr.
Maximum Contour .5 mrem/yr.



Columbia River



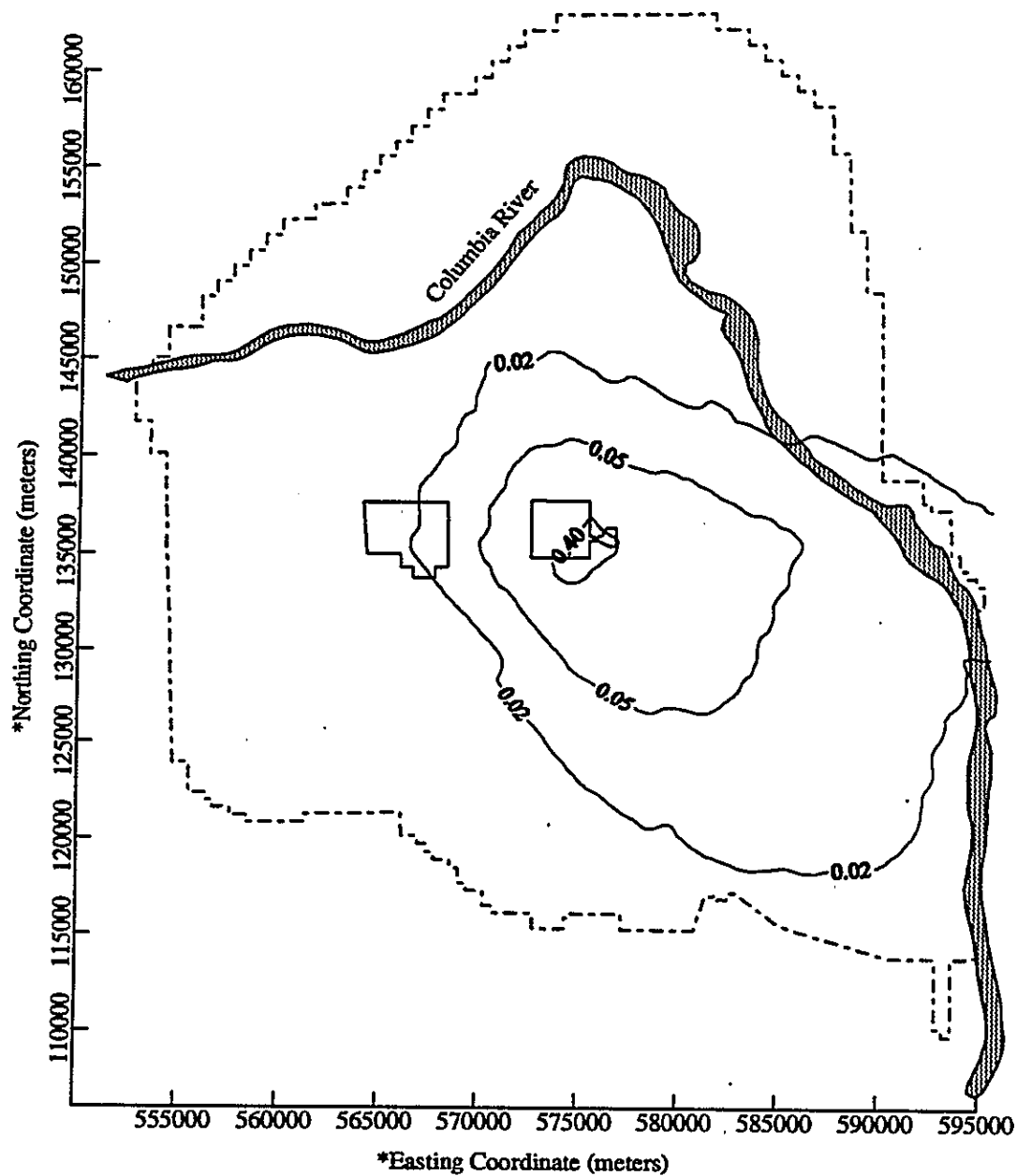
Hanford Site Boundary



200 East and West Operating Areas

* Washington State Plane Coordinates

Figure G.4.0.3 Radionuclide Dose (mrem/yr) for the Long-Term Management Alternative (Phase 2)



LEGEND

Minimum Contour .02 mrem/yr.
Maximum Contour .40 mrem/yr.



Columbia River



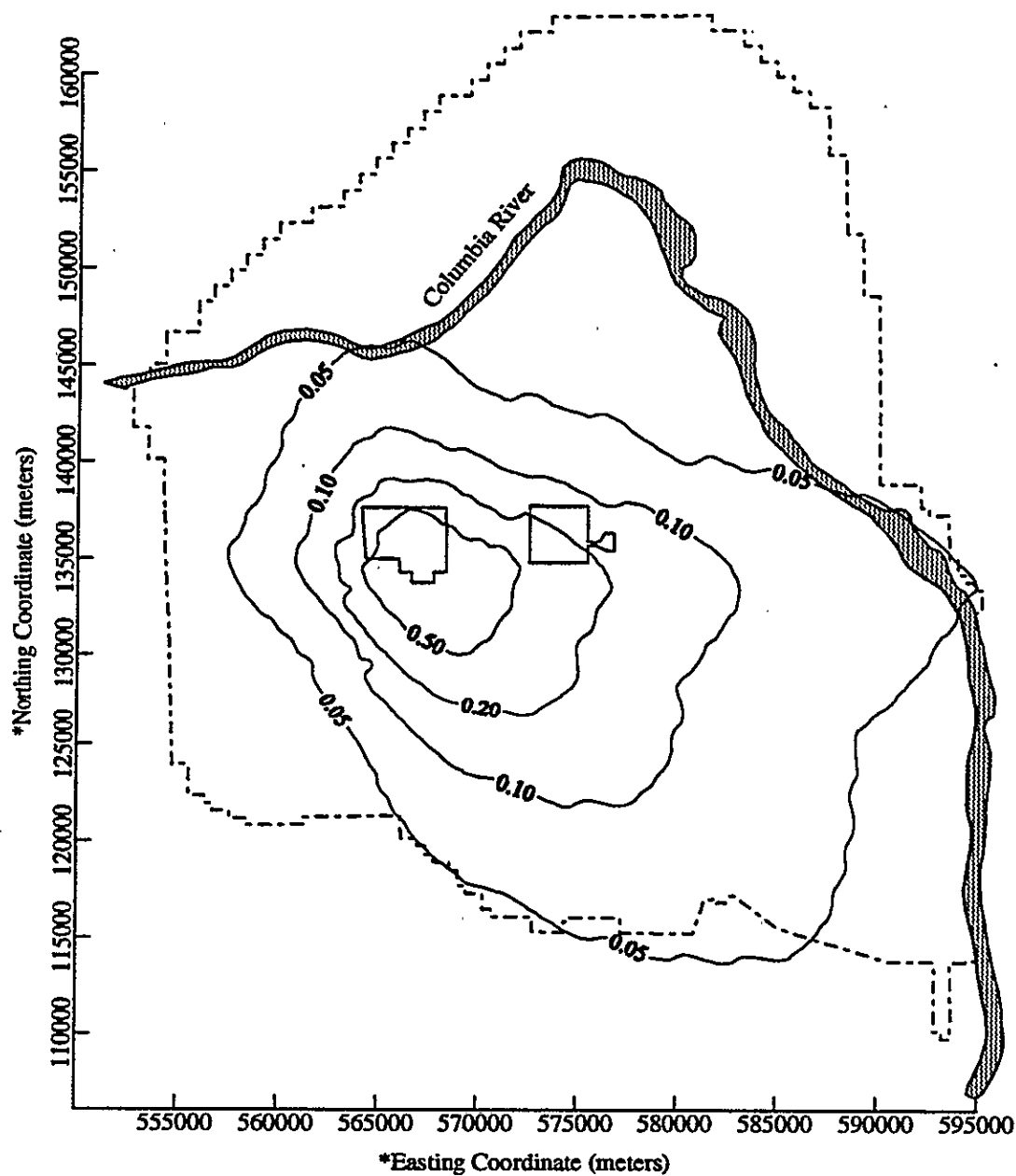
Hanford Site Boundary



200 East and West Operating Areas

* Washington State Plane Coordinates

**Figure G.4.0.4 Radionuclide Dose (mrem/yr) for the
In Situ Fill and Cap Alternative**



LEGEND

Minimum Contour .05 mrem/yr.
Maximum Contour .5 mrem/yr.



Columbia River



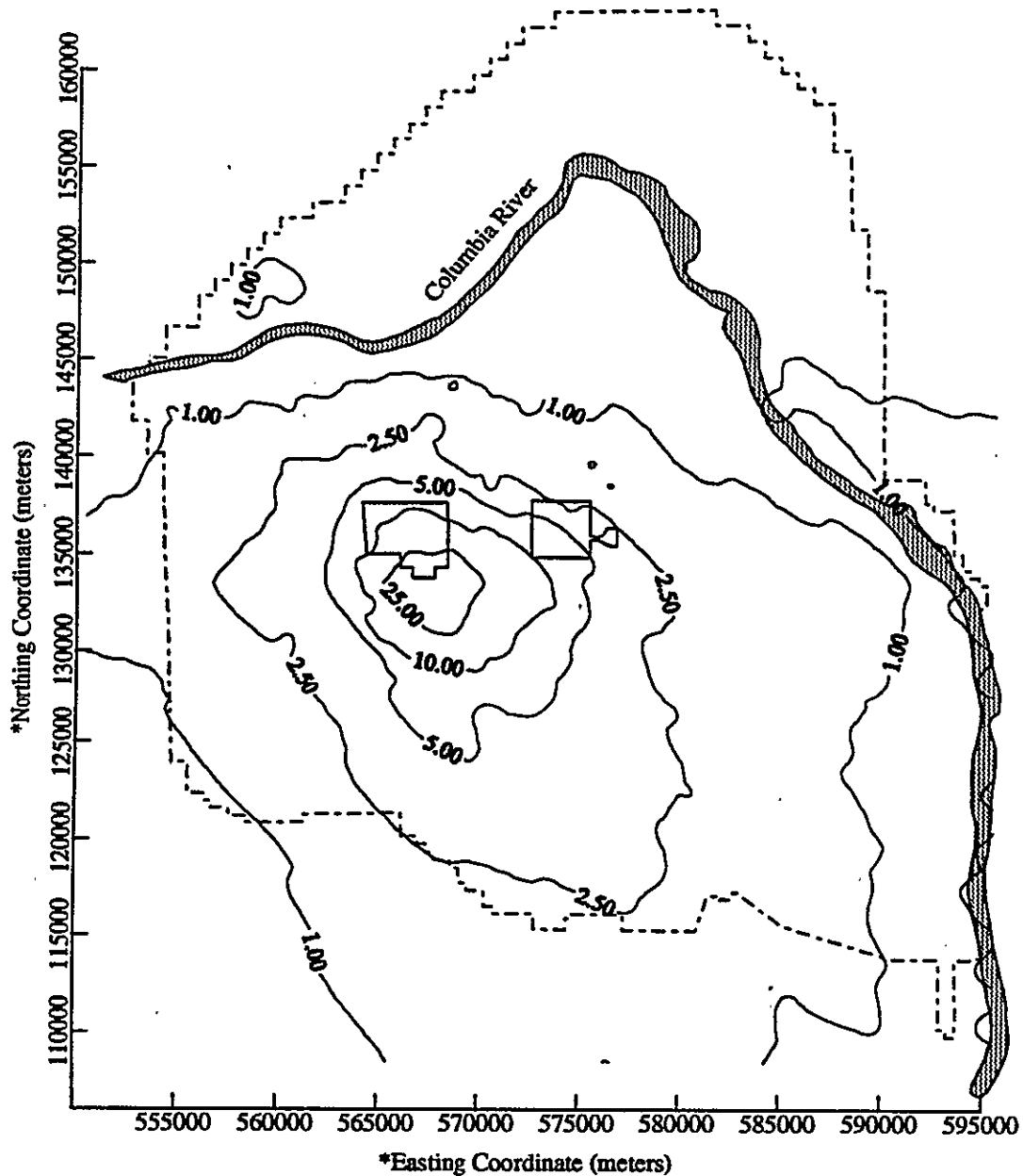
Hanford Site Boundary



200 East and West Operating Areas

* Washington State Plane Coordinates

**Figure G.4.0.5 Radionuclide Dose (mrem/yr) for the
In Situ Vitrification Alternative**



LEGEND

Minimum Contour 1 mrem/yr.
Maximum Contour 25 mrem/yr.



Columbia River



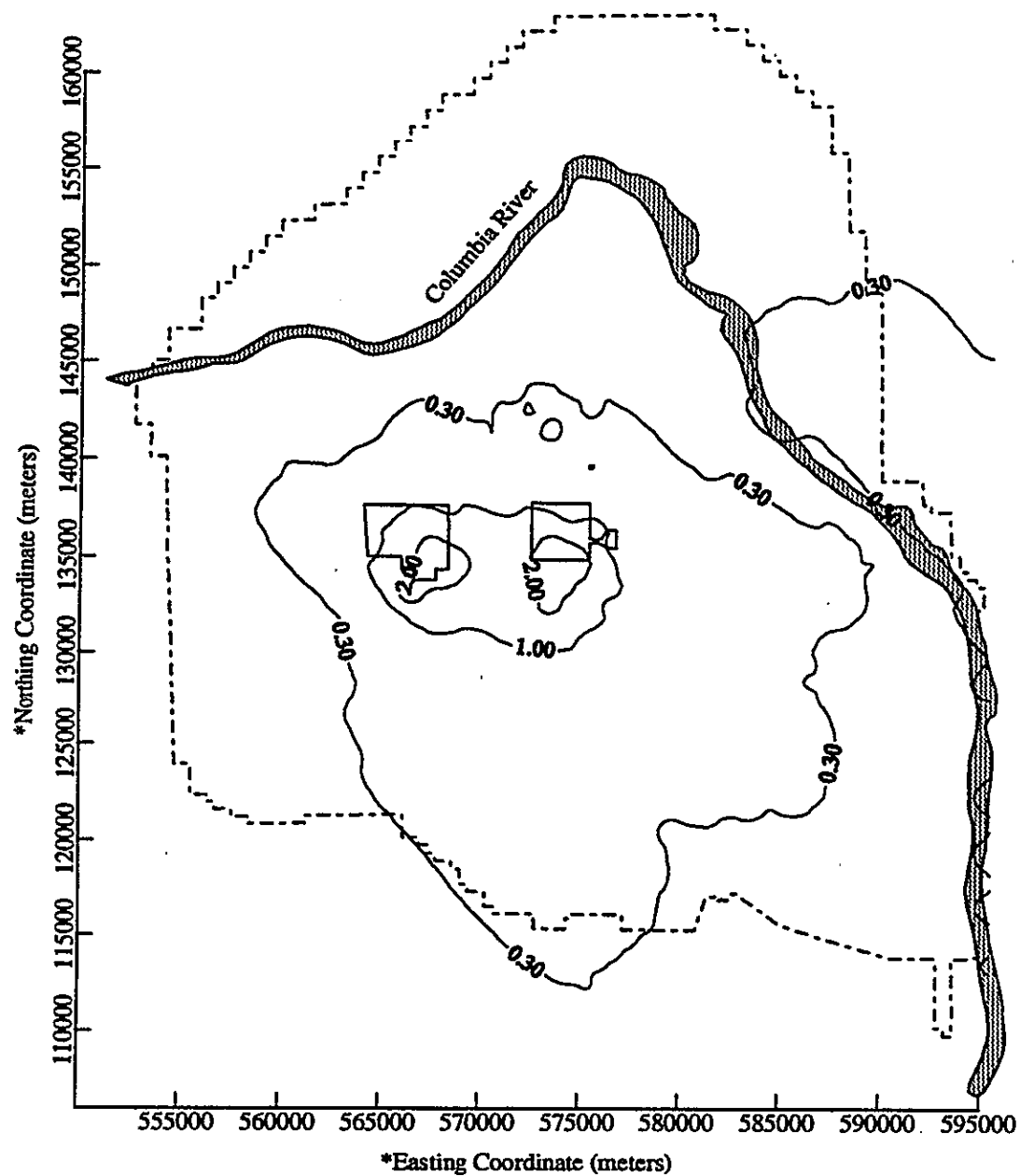
Hanford Site Boundary



200 East and West Operating Areas

* Washington State Plane Coordinates

**Figure G.4.0.6 Radionuclide Dose (mrem/yr) for the
Ex Situ Intermediate Separations Alternative**



LEGEND

Minimum Contour .3 mrem/yr.
Maximum Contour 2 mrem/yr.



Columbia River



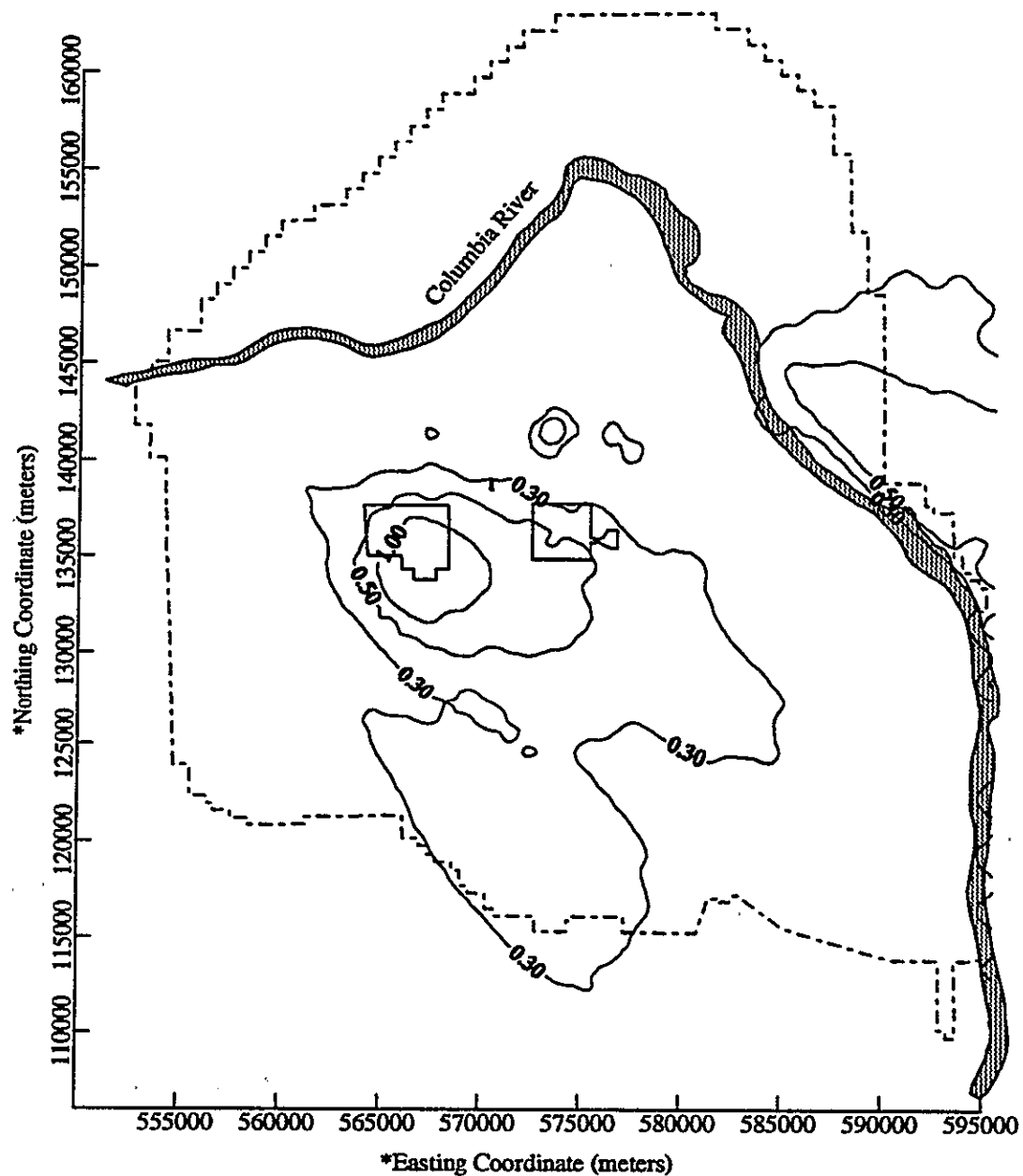
Hanford Site Boundary



200 East and West Operating Areas

* Washington State Plane Coordinates

**Figure G.4.0.7 Radionuclide Dose (mrem/yr) for the
Ex Situ No Separations Alternative (Vitrification)**



LEGEND

Minimum Contour .3 mrem/yr.
Maximum Contour 1 mrem/yr.



Columbia River



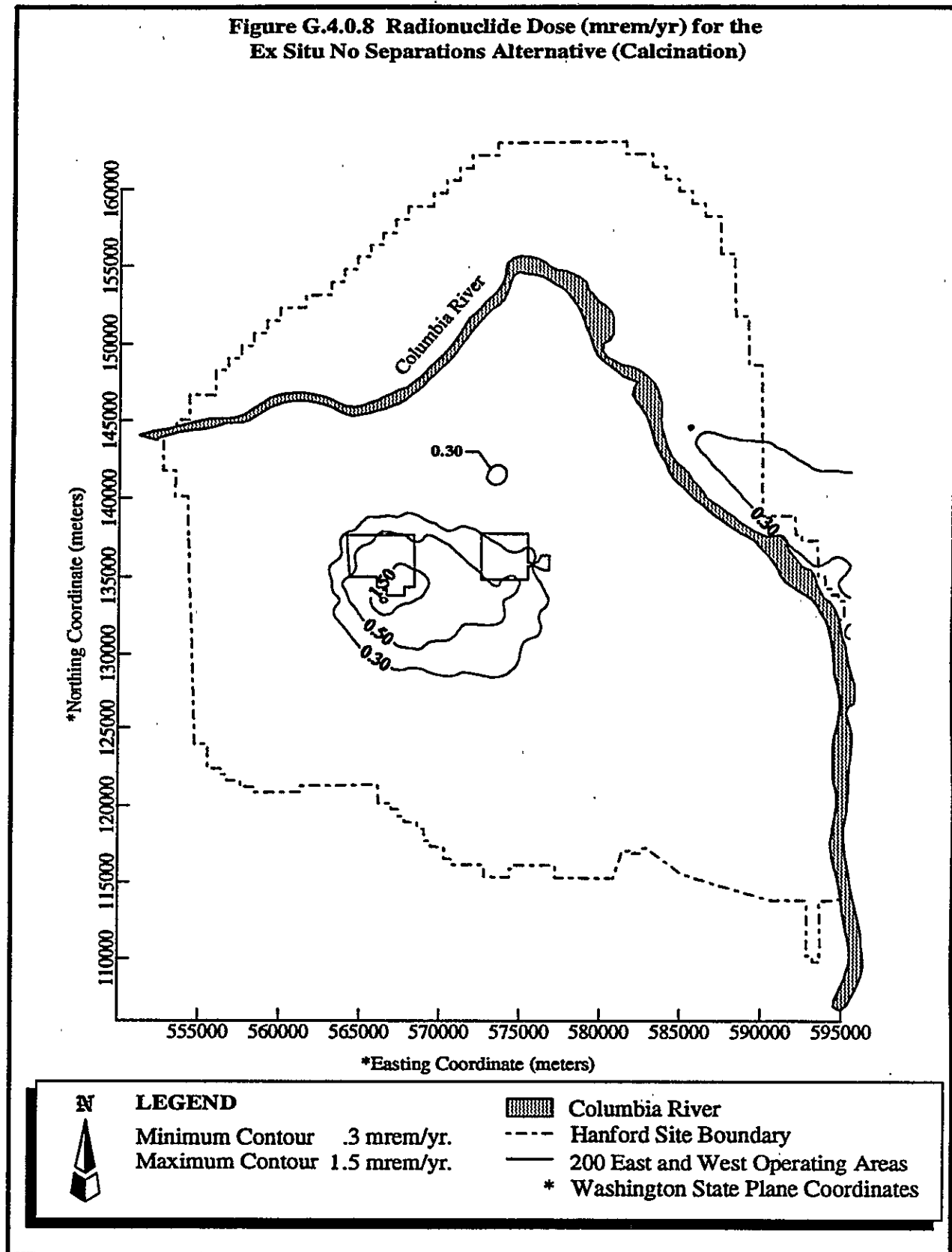
Hanford Site Boundary



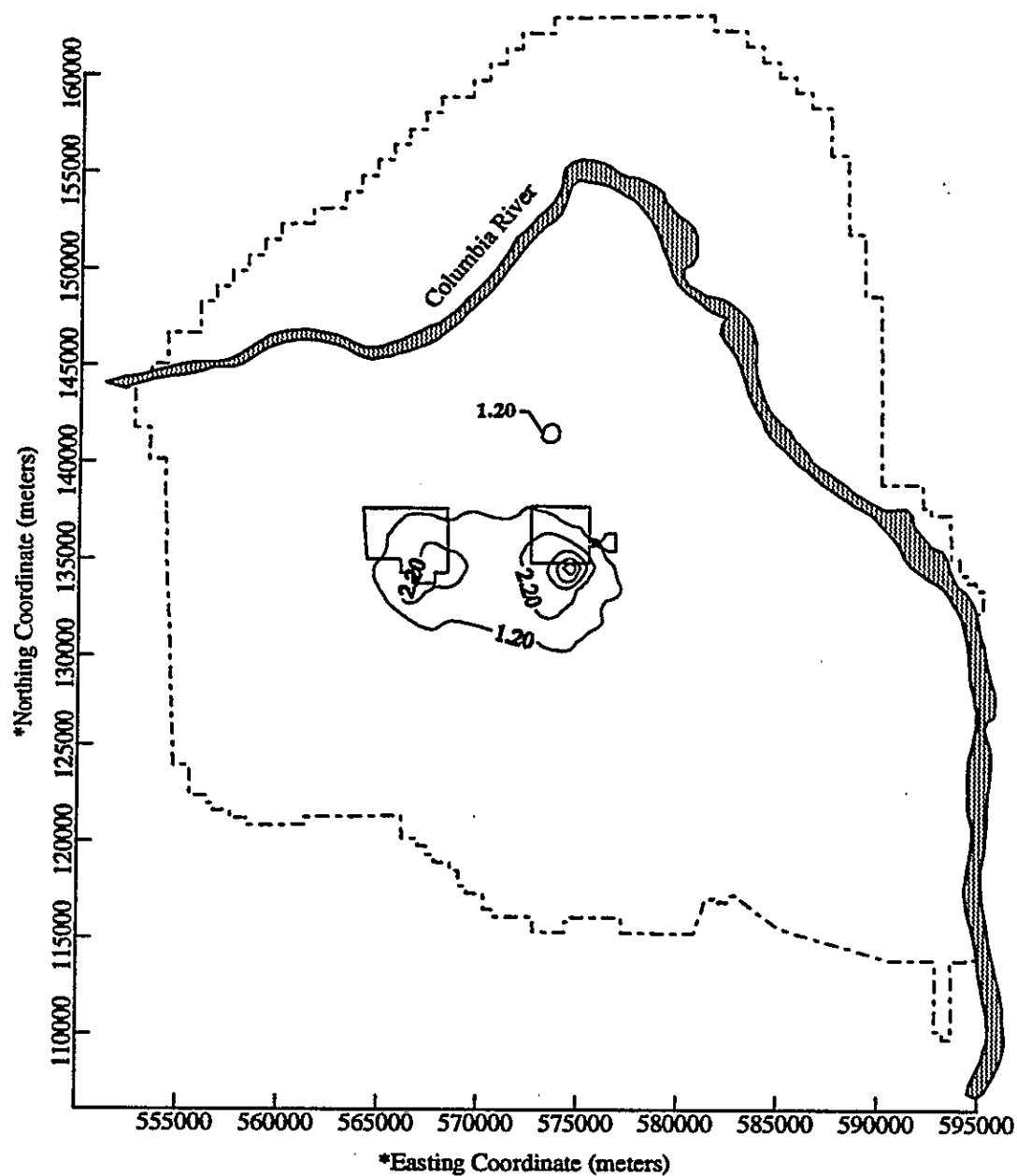
200 East and West Operating Areas

* Washington State Plane Coordinates

**Figure G.4.0.8 Radionuclide Dose (mrem/yr) for the
Ex Situ No Separations Alternative (Calcination)**



**Figure G.4.0.9 Radionuclide Dose (mrem/yr) for the
Ex Situ Extensive Separations Alternative**



LEGEND

Minimum Contour 1.2 mrem/yr.
Maximum Contour 2.2 mrem/yr.



Columbia River



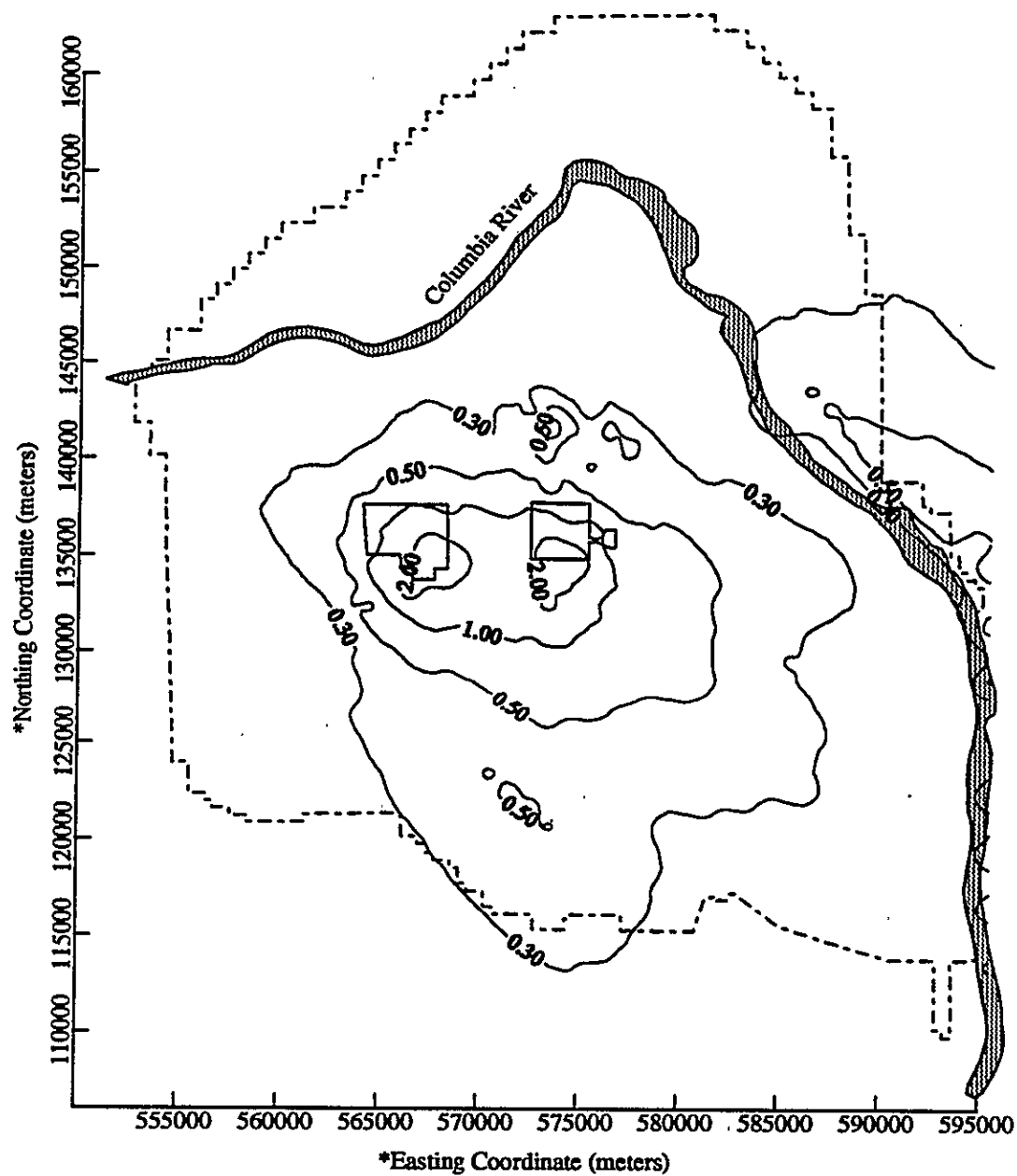
Hanford Site Boundary



200 East and West Operating Areas

* Washington State Plane Coordinates

**Figure G.4.0.10 Radionuclide Dose (mrem/yr) for the
Ex Situ/In Situ Combination Alternative**



LEGEND

Minimum Contour .3 mrem/yr.
Maximum Contour 2 mrem/yr.



Columbia River



Hanford Site Boundary



200 East and West Operating Areas

* Washington State Plane Coordinates

Figure G.4.0.11 Radionuclide Dose (mrem/yr) for the
Phased Implementation Alternative - Phase 1

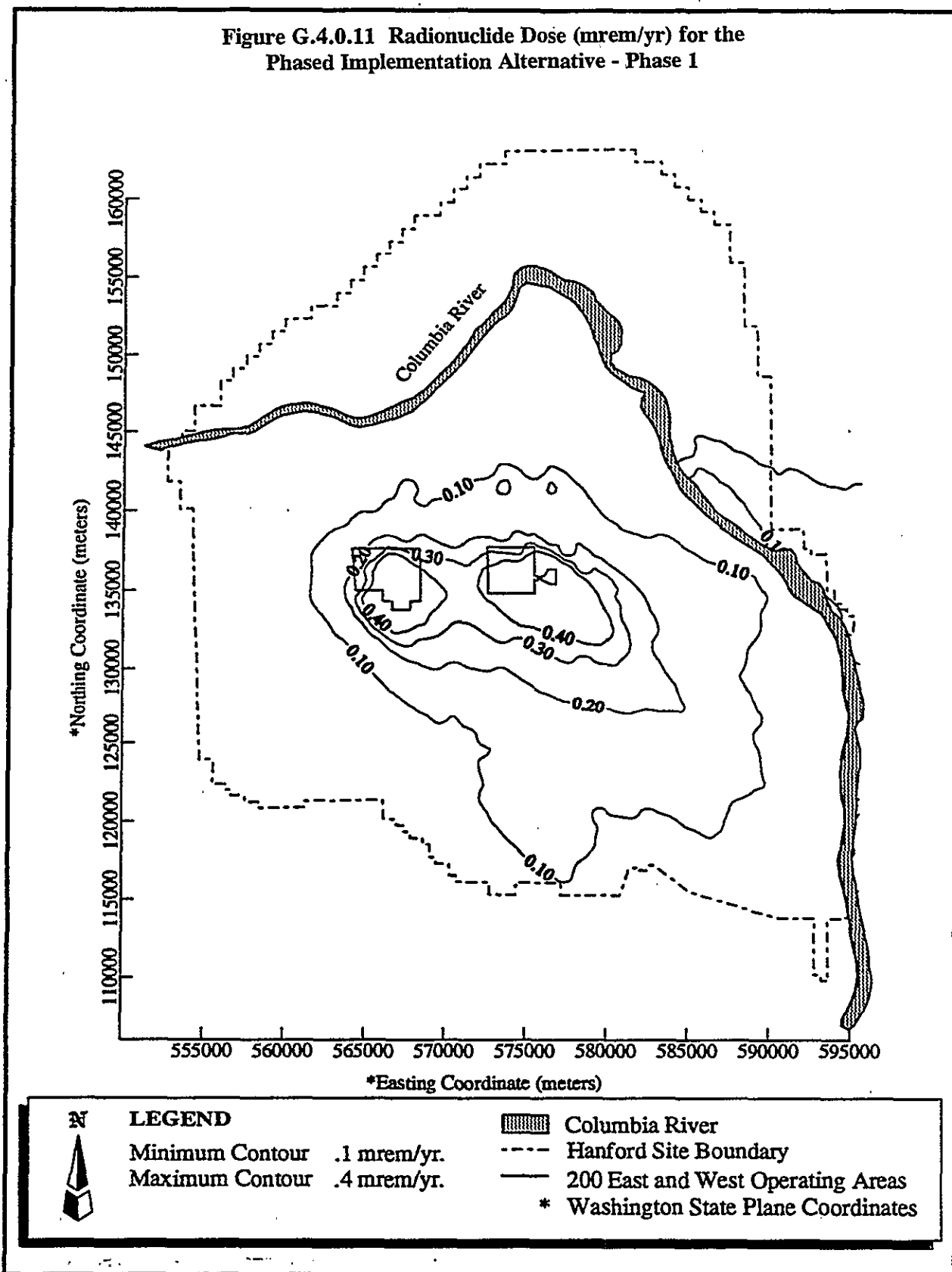
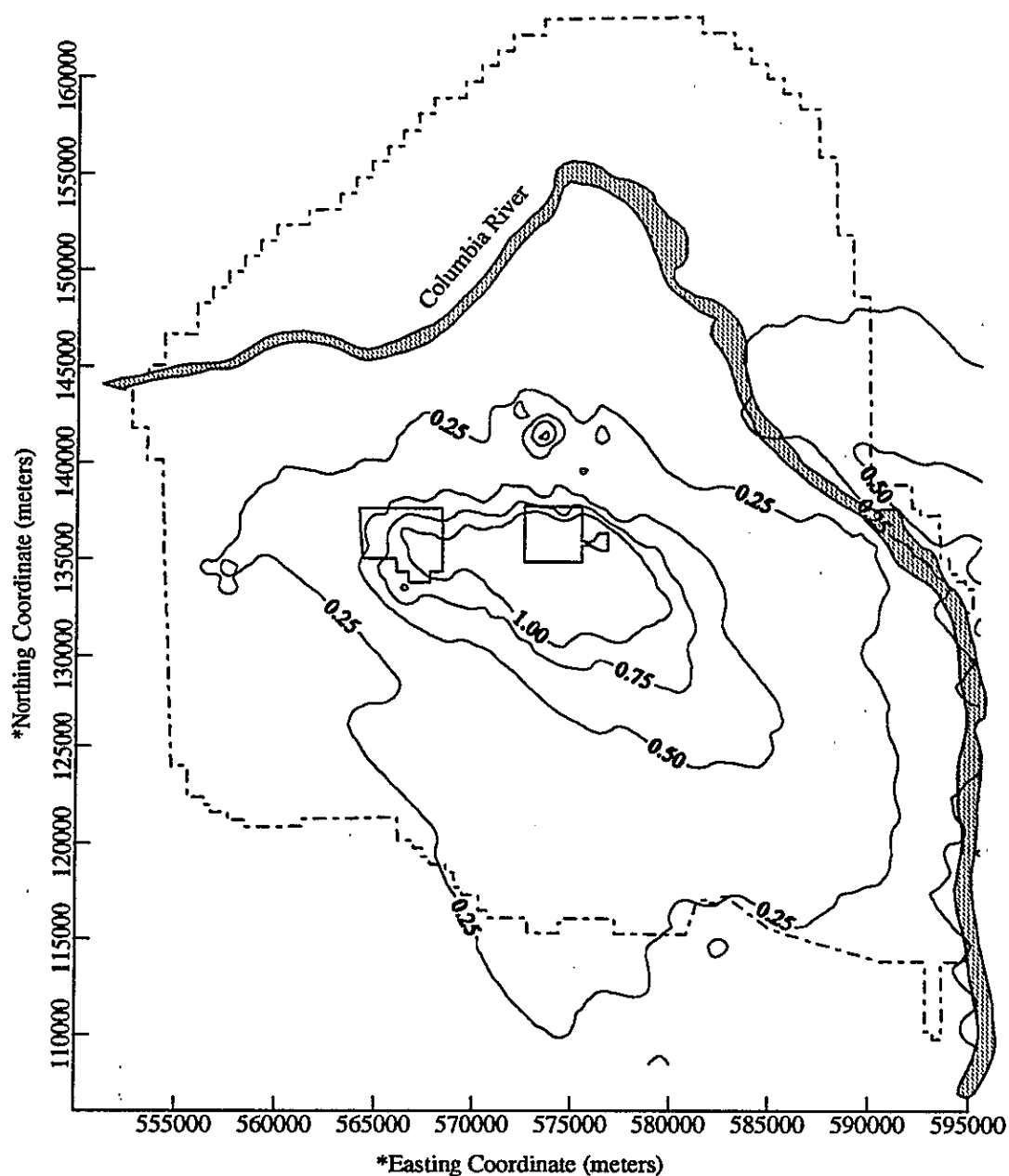


Figure G.4.0.12 Radionuclide Dose (mrem/yr) for the
Phased Implementation Alternative - Phase 2



LEGEND

Minimum Contour .25 mrem/yr.
Maximum Contour 1 mrem/yr.
Contour Interval .25 mrem/yr.



Columbia River



Hanford Site Boundary



200 East and West Operating Areas

* Washington State Plane Coordinates

Table G.3.1.1 Source Locations and Parameters

Source Name **	Source Location*		Side Length (m)	Elevation of Center (m)	Source Type	Stack Height (m)
	x coord.	y coord.				
TF1E	573556	137442	114	200	AREA	---
TF2E	573556	137282	114	200	AREA	---
TF3E	573771	137252	114	200	AREA	---
TF4E	575075	136493	149	200	AREA	---
TF5E	575332	136378	91	205	AREA	---
TF6E	575365	136279	61	205	AREA	---
TF7E	575281	136157	61	205	AREA	---
TF8E	575380	136159	56	205	AREA	---
TF9E	575310	136015	86	210	AREA	---
TF10E	575304	135806	101	210	AREA	---
TF11E	575481	135747	152	210	AREA	---
TF1W	566738	136662	118	210	AREA	---
TF2W	566715	136373	87	210	AREA	---
TF3W	566689	136146	145	210	AREA	---
TF4W	566744	135000	118	205	AREA	---
TF5W	566750	134399	176	205	AREA	---
TF6W	566746	134162	145	205	AREA	---
TA1W	566833	136570	35	210	AREA	---
TA2W	566886	134878	80	205	AREA	---
TA3W	566930	134444	35	205	AREA	---
TA1E	573755	137383	35	200	AREA	---
TA2E	575163	136336	35	200	AREA	---
PROC	573879	135229	875	215	AREA	---
BTCH	571332	135953	578	225	AREA	---
SMIN	574425	135978	N/A	215	POINT	54.86
ST-L	574120	135901	N/A	215	POINT	54.86
ST-H	574410	135978	N/A	215	POINT	54.86
CPF	573370	136370	60	200	AREA	---
DWSF	572141	136082	195	200	AREA	---
IS6W	566318	133734	N/A	205	POINT	30.00
EVAP	575374	135996	N/A	205	POINT	6.70
ESEP	574400	136000	N/A	205	POINT	54.86
WESF	573361	136433	N/A	205	POINT	21.34
SSPI	576210	135680	N/A	215	POINT	45.73
NSPI	576220	136080	N/A	215	POINT	45.73
FCPI	576180	135600	3.887	215	AREA	---

Notes:

* Location of area sources represents southwest corner of area (coordinates in meters)

** Tank farm sources have the prefix TF, transfer annex areas have the prefix TA; source IDs ending in E are located in the 200 East Area, while those ending in W are located in the 200 West Area. Other sources are defined as follows:

BTCH = Concrete batch plant emissions

CPF = Capsule Packaging Facility

DWSF = Dry-Well Storage Facility

ESEP = Extensive Separations facility process stack

EVAP = Evaporator

IS6W = ISV Stack located adjacent to TF6W

PROC = Vitrification process facility construction emissions

SMIN = No Separations process stack

ST-H = Intermediate Separations, HLW facility process stack

ST-L = Intermediate Separations, LAW facility process stack

WESF = Waste Encapsulation and Storage Facility Stack

Coordinates are Washington State plane coordinates

Table G.3.1.2 Emission Rates for the No Action Alternative (Tank Waste)

Pollutant	Source	Emission Rate (g/sec)	Source	Emission Rate (g/sec)	Source	Emission Rate (g/sec)	Source	Emission Rate (g/sec)
Carbon Monoxide	TF1E	1.29E-04	TF2E	2.40E-04	TF3E	3.06E-04	TF4E	1.8.E-04
	TF8E	7.86E-05	TF9E	1.07E-04	TF1W	3.86E-07	TF2W	1.48E-07
	TF3W	3.11E-07	TF4W	3.69E-07	TF5W	2.00E-06	TF6W	7.14E-06
Nitrogen Oxides	TF1E	7.97E-06	TF2E	1.44E-05	TF3E	1.84E-05	TF4E	1.25E-05
	TF5E	1.15E-05	TF6E	3.29E-06	TF7E	3.29E-06	TF8E	4.80E-06
	TF9E	6.44E-06	TF10E	9.86E-06	TF11E	1.32E-05	TF1W	2.31E-08
	TF2W	8.91E-09	TF3W	2.19E-08	TF4W	2.22E-08	TF5W	2.34E-08
	TF6W	1.68E-09						
1,3 butadiene	TF1E	5.58E-07	TF2E	1.04E-06	TF3E	1.33E-06	TF4E	7.97E-07
	TF5E	8.31E-07	TF6E	2.38E-07	TF7E	2.38E-07	TF8E	3.28E-07
	TF9E	4.67E-07	TF10E	7.14E-07	TF11E	9.50E-07	TF1W	1.67E-09
	TF2W	6.44E-10	TF3W	1.45E-09	TF4W	1.60E-09	TF5W	2.10E-09
	TF6W	1.82E-09						
2-hexanone	TF1E	1.03E-05	TF2E	1.89E-05	TF3E	2.41E-05	TF4E	1.45E-05
	TF5E	1.51E-05	TF6E	4.33E-06	TF7E	4.33E-06	TF8E	6.31E-06
	TF9E	8.47E-06	TF10E	1.30E-05	TF11E	1.73E-05	TF1W	3.03E-08
	TF2W	1.17E-08	TF3W	2.64E-08	TF4W	2.92E-08	TF5W	3.80E-08
	TF6W	3.33E-08	EVAP	8.3E-07				
2-pentanone	TF1E	1.64E-05	TF2E	3.008E-	TF3E	3.8.E-05	TF4E	2.29E-05
	TF5E	2.40E-05	TF6E	6.87E-06	TF7E	6.87E-06	TF8E	8.86E-06
	TF9E	1.34E-05	TF10E	2.06E-05	TF11E	2.74E-05	TF1W	4.83E-08
	TF2W	1.86E-08	TF3W	4.19E-08	TF4W	4.61E-08	TF5W	6.05E-08
	TF6W	5.27E-08						
Acetone	TF1E	1.95E-04	TF2E	3.61E-04	TF3E	4.58E-04	TF4E	2.76E-04
	TF5E	2.89E-04	TF6E	8.22E-05	TF7E	8.22E-05	TF8E	1.20E-04
	TF9E	1.61E-04	TF10E	2.47E-04	TF11E	3.31E-04	TF1W	5.81E-07
	TF2W	2.23E-07	TF3W	5.03E-07	TF4W	5.56E-07	TF5W	7.25E-07
	TF6W	6.31E-07	EVAP	2.3E-04				
Acetonitrile	TF1E	9.36E-05	TF2E	1.74E-04	TF3E	2.21E-04	TF4E	1.33E-04
	TF5E	1.39E-04	TF6E	3.97E-05	TF7E	3.97E-05	TF8E	5.81E-05
	TF9E	7.78E-05	TF10E	1.19E-04	TF11E	1.59E-04	TF1W	2.81E-07
	TF2W	1.08E-07	TFW3	2.43E-07	TF4W	2.68E-07	TF5W	3.49E-07
	TF6W	3.04E-07						

Table G.3.1.2 Emission Rates for the No Action Alternative (Tank Waste) (cont'd)

Pollutant	Source	Emission Rate (g/sec)	Source	Emission Rate (g/sec)	Source	Emission Rate (g/sec)	Source	Emission Rate (g/sec)
Ammonia	TF1E	9.94E-04	TF2E	1.66E-03	TF3E	2.11E-03	TF4E	1.44E-03
	TF8E	5.53E-04	TF9E	7.42E-04	TF1W	2.66E-06	TF2W	1.03E-06
	TF3W	4.17E-10	TF4W	2.55E-06	TF5W	3.33E-05	TF6W	1.32E-04
	EVAP	2.2E-04						
Benzene	TF1E	4.50E-06	TF2E	8.28E-06	TF3E	1.05E-05	TF4E	6.31E-06
	TF5E	6.58E-06	TF6E	1.89E-06	TF7E	1.89E-06	TF8E	2.76E-06
	TF9E	3.69E-06	TF10E	5.67E-06	TF11E	7.53E-06	TF1W	1.33E-08
	TF2W	5.11E-06	TF3W	1.15E-08	TF4W	3.42E-08	TF5W	1.66E-08
	TF6W	1.45E-08						
Heptane	TF1E	1.17E-05	TF2E	2.12E-05	TF3E	2.70E-05	TF4E	1.62E-05
	TF5E	1.69E-05	TF6E	4.83E-06	TF7E	4.83E-06	TF8E	7.08E-06
	TF9E	9.50E-06	TF10E	1.45E-05	TF11E	1.93E-05	TF1W	3.42E-08
	TF2W	1.31E-08	TF3W	2.94E-08	TF4W	3.25E-08	TF5W	4.27E-08
	TF6W	3.69E-08						
Hexane	TF1E	1.26E-05	TF2E	2.21E-05	TF3E	2.81E-05	TF4E	1.69E-05
	TF5E	1.76E-05	TF6E	5.06E-06	TF7E	5.06E-06	TF8E	7.36E-06
	TF9E	9.89E-06	TF10E	1.51E-05	TF11E	2.02E-05	TF1W	3.56E-08
	TF2W	1.37E-08	TF3W	3.08E-08	TF4W	3.39E-08	TF5W	4.44E-08
	TF6W	3.87E-08						
Methyl Amyl Ketone	TF1E	1.11E-05	TF2E	2.05E-05	TF3E	2.61E-05	TF4E	1.56E-05
	TF5E	1.64E-05	TF6E	4.68E-06	TF7E	4.68E-06	TF8E	6.83E-06
	TF9E	9.17E-06	TF10E	1.40E-05	TF11E	1.87E-05	TF1W	3.31E-08
	TF2W	1.27E-08	TF3W	2.86E-08	TF4W	3.17E-08	TF5W	4.14E-08
	TF6W	3.60E-08						
Methyl Isobutyl Ketone	EVAP	1.6E-05						
n-Butyl alcohol	EVAP	1.73E-03						
Nonane	TF1E	6.25E-06	TF2E	1.15E-05	TF3E	1.47E-05	TF4E	8.81E-06
	TF5E	9.19E-06	TF6E	2.64E-06	TF7E	2.64E-06	TF8E	3.8E-06
	TF9E	5.17E-06	TF10E	7.89E-06	TF11E	1.05E-05	TF1W	1.94E-08
	TF2W	7.47E-09	TF3W	1.68E-08	TF4W	1.86E-08	TF5W	2.43E-08
	TF6W	2.12E-08						

Table G.3.1.2 Emission Rates for the No Action Alternative (Tank Waste) (cont'd)

Pollutant	Source	Emission Rate (g/sec)	Source	Emission Rate (g/sec)	Source	Emission Rate (g/sec)	Source	Emission Rate (g/sec)
Octane	TF1E	6.64E-06	TF2E	1.21E-05	TF3E	1.54E-05	TF4E	9.22E-06
	TF5E	9.64E-06	TF6E	2.76E-06	TF7E	2.76E-06	TF8E	4.03E-06
	TF9E	5.42E-06	TF10E	8.25E-06	TF11E	1.10E-05	TF1W	1.94E-08
	TF2W	7.47E-09	TF3W	1.68E-08	TF4W	1.86E-08	TF5W	2.43E-08
	TF6W	2.12E-08						
Phos Acid, Tributyl Ester	TF1E	2.33E-05	TF2E	4.33E-05	TF3E	1.47E-05	TF4E	8.81E-06
	TF5E	9.19E-06	TF6E	2.64E-06	TF7E	2.64E-06	TF8E	3.83E-06
	TF9E	5.17E-06	TF10E	7.89E-06	TF11E	1.05E-05	TF1W	1.85E-08
	TF2W	7.14E-09	TF3W	1.61E-08	TF4W	1.77E-08	TF5W	2.32E-08
	TF6W	2.02E-08						
Toluene	TF1E	9.92E-07	TF2E	1.68E-06	TF3E	2.14E-06	TF4E	1.28E-06
	TF5E	1.34E-06	TF6E	3.85E-07	TF7E	3.85E-07	TF8E	5.61E-07
	TF9E	7.53E-07	TF10E	1.15E-06	TF11E	1.54E-06	TF1W	2.70E-09
	TF2W	1.04E-09	TF3W	1.24E-10	TF4W	2.38E-09	TF5W	3.38E-09
	TF6W	2.95E-09						

Notes:

g/sec = Grams per second

Table G.3.1.3 Emission Rates for the Long-Term Management Alternative Phase 1 (First Retanking)

Pollutant	Source	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	PROC	6.9E-03
Carbon Monoxide	PROC	1.38E-01
Nitrogen Oxides	PROC	2.05E-02
PM-10	PROC	1.86E-01
Hazardous/Toxic Air Pollutants		
Formaldehyde	PROC	6.73E-04
In addition, emissions from tank farms TF1E - TF11E and TF1W - TF5W, identical to those shown in Table G.3.1.2, would occur. Emissions from tank farm TF6W (during retrieval) were used to determine bounding emission rates and are shown below.		
Carbon Monoxide	TF6W	9.17E-04
Nitrogen Oxides	TF6W	5.51E-05
1,3-butadiene	TF6W	3.98E-06
2-hexanone	TF6W	7.23E-05
2-pentanone	TF6W	1.15E-04
Acetone	TF6W	1.38E-03
Acetonitrile	TF6W	6.64E-04
Ammonia	TF6W	6.33E-03
Benzene	TF6W	3.16E-05
Heptane	TF6W	8.10E-05
Hexane	TF6W	8.42E-05
Nonane	TF6W	4.41E-05
Octane	TF6W	4.61E-05
Phosphoric acid, Tributyl Ester	TF6W	1.30E-04
Toluene	TF6W	6.43E-06

Notes:

g/sec = Grams per second

Table G.3.1.4 Emission Rates for the Long-Term Management Alternative Phase 2 (Second Retanking)

Pollutant	Source	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	PROC	6.9E-03
Carbon Monoxide	PROC	1.39E-01
Nitrogen Oxides	PROC	2.06E-02
PM-10	PROC	1.86E-01
Hazardous/Toxic Air Pollutants		
Formaldehyde	PROC	6.73E-04
1,3-butadiene	PROC	8.07E-06
2-hexanone	PROC	1.47E-04
2-pentanone	PROC	2.33E-04
Acetone	PROC	2.81E-03
Acetonitrile	PROC	1.35E-03
Ammonia	PROC	8.26E-03
Benzene	PROC	6.43E-05
Heptane	PROC	1.65E-04
Hexane	PROC	1.72E-04
Nonane	PROC	8.96E-05
Octane	PROC	9.40E-05
Phosphoric acid, Tributyl Ester	PROC	1.42E-04
Toluene	PROC	1.32E-05

Notes:

g/sec = Grams per second

Table G.3.1.5 Emission Rates for the In Situ Fill and Cap Alternative

Pollutant	Source	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF6W	2.4E-01
Carbon Monoxide	TF6W	5.0E-01
Nitrogen Oxides	TF6W	1.12E+00
PM-10	TF6W BTCH TF5W	6.6E-01 3.3E-01 5.56E-02
Hazardous/Toxic Air Pollutants		
Formaldehyde	TF6W	1.90E-04
In addition, emissions from tank farms TF1E - TF11E and TF1W - TF4W, identical to those shown in Table G.3.1.2, would occur. Emissions from tank farms TF5W and TF6W (during filling) were used to determine bounding emission rates and are shown below.		
Carbon Monoxide	TF5W, TF6W	4.89E-04
Nitrogen Oxides	TF5W, TF6W	2.94E-05
1,3-butadiene	TF5W, TF6W	2.12E-06
2-hexanone	TF5W, TF6W	3.86E-05
2-pentanone	TF5W, TF6W	6.13E-05
Acetone	TF5W, TF6W	7.33E-04
Acetonitrile	TF5W, TF6W	3.54E-04
Ammonia	TF5W, TF6W	3.38E-03
Benzene	TF5W, TF6W	1.68E-05
Heptane	TF5W, TF6W	4.32E-05
Hexane	TF5W, TF6W	4.49E-05
Nonane	TF5W, TF6W	2.35E-05
Octane	TF5W, TF6W	2.46E-05
Phosphoric acid, Tributyl Ester	TF5W, TF6W	6.93E-05
Toluene	TF5W, TF6W	6.43E-06

Notes:

g/sec = Grams per second

Table G.3.1.6 Emission Rates for the In Situ Vitrification Alternative

Pollutant	Source	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF6W (construction)	6.85E-01
Carbon Monoxide	TF6W (construction)	9.92E+00
Nitrogen Oxides	TF6W (construction)	3.3E+00
	IS6W (operations)	6.86E-01
PM-10	TF6W (construction)	2.41E+00
	IS6W (operations)	1.14E-01
Hazardous/Toxic Air Pollutants		
Formaldehyde	TF6W (construction)	7.74E-04
Ammonia	IS6W (operations)	1.07E-01

Notes:

g/sec = Grams per second

Routine emissions from tank farm sources TF1E - TF11E and TF1W - TF5W and from the evaporator (EVAP) would occur as shown in Table G.3.1.2.

Table G.3.1.7 Emission Rates for the Ex Situ Intermediate Separations Alternative - Construction Phase

Pollutant	Source :	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF5W	1.77E-03
	TF6W	1.77E-03
	TA1W	7.18E-03
	TA2W	3.77E-02
	TA3W	7.18E-03
	TA1E	7.18E-03
	TA2E	7.18E-03
	PROC	2.13E-01
Carbon Monoxide	TF5W	3.72E-02
	TF6W	3.72E-02
	TA1W	9.69E-02
	TA2W	0.510
	TA3W	9.69E-02
	TA1E	9.69E-02
	TA2E	9.69E-02
	PROC	1.60E+02
Nitrogen Dioxide	TF5W	1.46E-01
	TF6W	1.46E-01
	TA1W	3.15E-01
	TA2W	1.66
	TA3W	3.15E-01
	TA1E	3.15E-01
	TA2E	3.15E-01
	PROC	1.6E+01
PM-10	TF5W	1.03E-02
	TF6W	1.03E-02
	TA1W	7.40E-02
	TA2W	3.88E-01
	TA3W	7.40E-02
	TA1E	7.40E-02
	TA2E	7.40E-02
	PROC	6.67E+00
	BTCH	3.17E+00
Hazardous Air Pollutants		
Formaldehyde	TF5W	3.61E-05
	TF6W	3.61E-05
	TA1W	9.33E-05
	TA2W	4.89E-04
	TA3W	9.33E-05
	TA1E	9.33E-05
	TA2E	9.33E-05
	PROC	3.89E-03

Notes:

g/sec = Grams per second

Routine emissions from tank farms and evaporator would occur as shown in Table G.3.1.2

Table G.3.1.8 Emission Rates for the Ex Situ Intermediate Separations Alternative - Operation Phase

Pollutant	Source	Emission Rates (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF5W, TF6W	1.77E-03
	ST-H	2.75E-02
	ST-L	7.56E-01
Carbon Monoxide	TF5W, TF6W	3.72E-02
	ST-H	1.21E+00
	ST-L	8.5E+00
Nitrogen Dioxide	TF5W, TF6W	1.46E-01
	ST-H	2.62E-02
	ST-L	5.14E-01
PM-10	TF5W, TF6W	1.03E-02
Hazardous Air Pollutants		
Formaldehyde	TF5W, TF6W	3.61E-05
Arsenic Compounds	ST-H	1.83E-09
	ST-L	8.8E-10
Beryllium Compounds	ST-H	4.67E-11
	ST-L	6.3E-12
Cadmium Compounds	ST-H	1.75E-08
	ST-L	7.6E-09
Cobalt Compounds	ST-H	1.96E-09
	ST-L	2.2E-10
Chromium Compounds	ST-H	9.86E-08
	ST-L	5.7E-07
Manganese Compounds	ST-H	3.50E-07
	ST-L	6.5E-08
Lead Compounds	ST-H	6.19E-08
	ST-L	9.4E-09
Antimony Compounds	ST-H	4.42E-09
	ST-L	2.3E-10
Selenium Compounds	ST-H	5.39E-09
	ST-L	2.7E-09
Nickel Compounds	ST-H	3.50E-04
	ST-L	3.2E-09
Hydrogen Chloride	ST-H	1.16E-02
	ST-L	9.6E-03
Iodine	ST-H	1.21E-05
	ST-L	1.39E-03
Ammonia	ST-H	0.000
	ST-L	1.12E-01
Silver Oxide	ST-H	8.03E-10
	ST-L	1.1E-10
Boric Oxide	ST-H	5.3E-06
	ST-L	3.0E-09

Table G.3.1.8 Emission Rates for the Ex Situ Intermediate Separations Alternative - Operation Phase (cont'd)

Pollutant	Source	Emission Rate (g/sec)
Calcium Oxide	ST-H	0
	ST-L	9.6E-06
Ferric Oxide	ST-H	2.12E-06
	ST-L	4.0E-08
Magnesium Oxide	ST-H	1.58E-08
	ST-L	9.5E-06
Tellurium Trioxide	ST-H	6.19E-10
	ST-L	2.1E-11
Uranium Trioxide	ST-H	2.81E-06
	ST-L	2.9E-07
Vanadium Pentoxide	ST-H	1.26E-10
	ST-L	5.2E-11
Zinc Oxide	ST-H	3.33E-09
	ST-L	3.3E-09
Zirconium Oxide	ST-H	1.36E-06
	ST-L	5.7E-08
Fluoride	ST-H	2.71E-02
	ST-L	2.24E-02
Nitric Acid	ST-H	5.06E-03
	ST-L	4.18E-03
Barium Oxide	ST-H	4.17E-09
	ST-L	1.0E-09

Notes:

g/sec = Grams per second

In addition, routine and retrieval emissions from tank farms and evaporator would occur as shown in Table G.3.1.3.

Table G.3.1.9 Emission Rates for the Ex Situ No Separations Alternative - Construction Phase

Pollutant	Source	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF5W	1.75E-03
	TF6W	1.75E-03
	TA1W	7.2E-03
	TA2W	3.8E-02
	TA3W	7.2E-03
	TA1E	7.2E-03
	TA2E	7.2E-03
	PROC	1.78E-01
Carbon Monoxide	TF5W	3.7E-02
	TF6W	3.7E-02
	TA1W	9.7E-02
	TA2W	5.10E-01
	TA3W	9.7E-02
	TA1E	9.7E-02
	TA2E	9.7E-02
	PROC	1.33E+02
Nitrogen Dioxide	TF5W	1.46E-01
	TF6W	1.46E-01
	TA1W	3.15E-01
	TA2W	1.66E+00
	TA3W	3.15E-01
	TA1E	3.15E-01
	TA2E	3.15E-01
	PROC	1.33E+01
PM-10	TF5W	1.03E-02
	TF6W	1.03E-02
	TA1W	7.4E-02
	TA2W	3.89E-01
	TA3W	7.4E-02
	TA1E	7.4E-02
	TA2E	7.4E-02
	PROC	5.57E+00
	BTCH	3.14E+00
Hazardous Air Pollutants		
Formaldehyde	TF5W	3.61E-05
	TF6W	3.61E-05
	TA1W	9.33E-05
	TA2W	4.89E-04
	TA3W	9.33E-05
	TA1E	9.33E-05
	TA2E	9.33E-05
	PROC	3.30E-03

Notes:

g/sec = Grams per second

Construction emissions for the vitrification and calcination options are the same.

Additional emissions from routine operation of tank farms and evaporator would occur as shown in Table G.3.1.2.

Table G.3.1.10 Emission Rates for the Ex Situ No Separations Alternative - Operation Phase

Pollutant	Source	Emission Rates (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF5W, TF6W, SMIN	1.75E-03 1.37E+00
Carbon Monoxide	TF5W, TF6W, SMIN	3.70E-02 1.36E+01
Nitrogen Dioxide	TF5W, TF6W SMIN(Vitrification)	1.46E-01 9.18E-01
PM-10	SMIN (Calcination) TF5W, TF6W	4.59E+00 1.03E-02
Hazardous Air Pollutants		
Formaldehyde	TF5W, TF6W	3.61E-05
Chlorine	SMIN	3.10E-01
Arsenic Compounds	SMIN	4.14E-11
Beryllium Compounds	SMIN	8.42E-11
Cadmium Compounds	SMIN	3.89E-10
Cobalt Compounds	SMIN	3.67E-11
Chromium Compounds	SMIN	8.39E-09
Manganese Compounds	SMIN	7.36E-09
Lead Compounds	SMIN	1.19E-09
Antimony Compounds	SMIN	7.94E-11
Selenium Compounds	SMIN	1.23E-10
Hydrogen Chloride	SMIN	4.50E-02
Iodine	SMIN	2.0E-03
Ammonia	SMIN	1.2E-01
Silver Oxide	SMIN	1.52E-11
Boric Oxide	SMIN	1.36E-06
Calcium Oxide	SMIN	1.05E-07
Ferric Oxide	SMIN	4.06E-08
Magnesium Oxide	SMIN	9.69E-08
Tellurium Trioxide	SMIN	1.11E-11
Uranium Trioxide	SMIN	5.67E-08
Vanadium Pentoxide	SMIN	2.75E-12
Zinc Oxide	SMIN	9.36E-11
Zirconium Oxide	SMIN	2.65E-08
Fluoride (as Hydrofluoric Acid)	SMIN	1.08E-01
Nitric Acid	SMIN	8.97E-03

Notes:

g/sec = Grams per second

Calcination emissions differ from vitrification only for nitrogen oxides.

Additional emissions from routine operations and retrieval operations from tank farms and evaporator would occur as shown in Table G.3.1.3.

Table G.3.1.11 Emission Rates for the Ex Situ Extensive Separations Alternative - Construction Phase

Pollutant	Source	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF5W	1.75E-03
	TF6W	1.75E-03
	TA1W	7.2E-03
	TA2W	3.8E-02
	TA3W	7.2E-03
	TA1E	7.2E-03
	TA2E	7.2E-03
	PROC	0.2558
Carbon Monoxide	TF5W	3.7E-02
	TF6W	3.7E-02
	TA1W	9.7E-02
	TA2W	5.10E-01
	TA3W	9.7E-02
	TA1E	9.7E-02
	TA2E	9.7E-02
	PROC	191.74
Nitrogen Dioxide	TF5W	1.46E-01
	TF6W	1.46E-01
	TA1W	3.15E-01
	TA2W	1.66E+00
	TA3W	3.15E-01
	TA1E	3.15E-01
	TA2E	3.15E-01
	PROC	19.176
PM-10	TF5W	1.03E-02
	TF6W	1.03E-02
	TA1W	5.46E-02
	TA2W	2.78E-01
	TA3W	5.46E-02
	TA1E	5.46E-02
	TA2E	5.46E-02
	PROC	6.901
	BTCH	1.82E+00
Hazardous Air Pollutants		
Formaldehyde	TF5W	7.2E-05
	TF6W	7.2E-05
	TA1W	1.86E-04
	TA2W	9.74E-04
	TA3W	1.86E-04
	TA1E	1.86E-04
	TA2E	1.86E-04
	PROC	4.781E-03

Notes:

g/sec = Grams per second

Table G.3.1.12 Emission Rates for the Ex Situ Extensive Separations Alternative - Operation Phase

Pollutant	Source	Emission Rates (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF5W, TF6W	1.75E-03
	ESEP	2.216
Carbon Monoxide	TF5W, TF6W	3.70E-02
	ESEP	8.105
Nitrogen Dioxide	TF5W, TF6W	1.46E-01
	ESEP	1.038
PM-10	TF5W, TF6W	1.03E-02
	ESEP	1.54E-05
Hazardous Air Pollutants		
Formaldehyde	TF5W, TF6W	3.61E-05
Chromium Compounds	ESEP	7.48E-05
Manganese Compounds	ESEP	1.64E-05
Nickle Compounds	ESEP	2.3E-06
Fluoride (as HF)	ESEP	2.10E-03
Nitric Acid	ESEP	3.61E-02
Hydrogen Peroxide	ESEP	4.67E-05
Formic Acid	ESEP	2.57E-03
Ammonia	ESEP	1.20E-01

Notes:

g/sec = Grams per second

Additional emissions from routine operations and retrieval operations would occur as shown in Table G.3.1.3.

Emission rates of all inorganic compounds are not given; however, negligible impacts similar to those predicted for the Ex Situ Intermediate Separations and Ex Situ No Separations alternatives are expected.

Table G.3.1.13 Emission Rates for the Ex Situ/In Situ Combination Alternative - Construction Phase

Pollutant	Source	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF5W	8.7E-04
	TF6W	0.24
	TA1W	3.6E-03
	TA2W	1.9E-02
	TA3W	3.6E-03
	TA1E	3.6E-03
	TA2E	3.6E-03
	PROC	8.0E-02
Carbon Monoxide	TF5W	1.9E-02
	TF6W	5.2E-01
	TA1W	4.8E-02
	TA2W	2.5E-01
	TA3W	4.8E-02
	TA1E	4.8E-02
	TA2E	4.8E-02
	PROC	6.17E+01
Nitrogen Dioxide	TF5W	7.3E-02
	TF6W	1.19E+00
	TA1W	1.6E-01
	TA2W	8.3E-01
	TA3W	1.6E-01
	TA1E	1.6E-01
	TA2E	1.6E-01
	PROC	5.86E+00
PM-10	TF5W	5.2E-03
	TF6W	6.7E-01
	TA1W	3.7E-02
	TA2W	1.94E-01
	TA3W	3.7E-02
	TA1E	3.7E-02
	TA2E	3.7E-02
	PROC BTCH	3.54E+00 1.20E+00
Hazardous Air Pollutants		
Formaldehyde	TF5W	1.81E-05
	TF6W	2.08E-04
	TA1W	4.67E-05
	TA2W	2.45E-04
	TA3W	4.67E-05
	TA1E	4.67E-05
	TA2E	4.67E-05
	PROC	1.51E-03

Notes:

g/sec = Grams per second

Additional emissions from tank farms and evaporator would occur as shown in Table G.3.1.2.

Table G.3.1.14 Emission Rates for the Ex Situ/In Situ Combination Alternative - Operation Phase

Pollutant	Source :	Emission Rates (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF5W, TF6W	8.7E-04
	ST-H	1.38E-02
	ST-L	3.78E-01
Carbon Monoxide	TF5W, TF6W	1.9E-02
	ST-H	6.07E-01
	ST-L	4.25E+00
Nitrogen Dioxide	TF5W, TF6W	7.3E-02
	ST-H	1.31E-02
	ST-L	0.257
PM-10	TF6W	5.2E-03
	TF5W	3.3E-02
	BTCH	1.7E-01
Hazardous Air Pollutants		
Formaldehyde	TF5W, TF6W	1.81E-05
Chlorine	ST-H	6.3E-03
	ST-L	1.5E-03
Arsenic Compounds	ST-H	9.2E-10
	ST-L	4.4E-10
Beryllium Compounds	ST-H	2.4E-11
	ST-L	3.2E-12
Cadmium Compounds	ST-H	8.8E-09
	ST-L	3.8E-09
Cobalt Compounds	ST-H	9.8E-10
	ST-L	1.1E-10
Chromium Compounds	ST-H	4.9E-08
	ST-L	2.9E-07
Manganese Compounds	ST-H	1.8E-07
	ST-L	3.3E-08
Lead Compounds	ST-H	3.1E-08
	ST-L	4.7E-09
Antimony Compounds	ST-H	2.2E-09
	ST-L	1.7E-10
Selenium Compounds	ST-H	2.7E-09
	ST-L	1.4E-09
Nickle Compounds	ST-H	1.8E-04
	ST-L	1.6E-09
Hydrogen Chloride	ST-H	5.8E-03
	ST-L	4.8E-03
Iodine	ST-H	6.0E-06
	ST-L	6.5E-04
Ammonia	ST-H	0.0
	ST-L	5.6E-02
Silver Oxide	ST-H	4.0E-10
	ST-L	5.5E-11
Boric Oxide	ST-H	2.79E-09
	ST-L	1.5E-09

Notes:

g/sec = Grams per second

Table G.3.1.15 Emission Rates for the Phased Implementation Alternative Phase 1 - Construction Phase

Pollutant	Source	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	FCPI	1.93E-01
Carbon Monoxide	FCPI	46.2
Nitrogen Dioxide	FCPI	8.59E+00
PM-10	FCPI	6.8E+00
	BTCH	3.15E+00
Hazardous Air Pollutants		
Formaldehyde	FCPI	3.50E-05

Notes:

g/sec = Grams per second

Routine emissions from tank farms and evaporator would occur as shown in Table G.3.1.2

Table G.3.1.16 Emission Rates for the Phased Implementation Alternative Phase 1 - Operation Phase

Pollutant	Source	Emission Rates (g/sec)
Criteria Pollutants		
Sulfur Oxides	SSPI	1.358E-01
	NSPI	2.338E-01
Carbon Monoxide	SSPI	2.27E+00
	NSPI	3.78E+00
Nitrogen Dioxide	SSPI	9.589E-02
	NSPI	1.613E-01
PM-10	SSPI	6.215E-03
	NSPI	1.287E-02
Hazardous Air Pollutants		
Chromium Compounds	SSPI	4.78E-08
	NSPI	8.88E-08
Manganese Compounds	SSPI	4.62E-09
	NSPI	3.70E-08
Nickel Compounds	SSPI	1.33E-09
	NSPI	3.70E-09
Fluoride (as HF)	SSPI	3.92E-02
	NSPI	6.69E-02
Nitric Acid	SSPI	8.88E-03
	NSPI	2.37E-02
Ammonia	SSPI	1.08E-02
	NSPI	2.62E-02
Hydrogen Chloride	SSPI	1.07E-03
	NSPI	1.79E-03

Notes:

g/sec = Grams per second

Additional emissions from routine operations and retrieval operations would occur as shown in Table G.3.1.2.

Emission rates of all inorganic compounds are not given; however, negligible impacts similar to those predicted for the Ex Situ Intermediate Separations and Ex Situ No Separations alternatives are expected.

Table G.3.1.17 Emission Rates for the Phased Implementation Alternative Phase 2 - Construction Phase

Pollutant	Source :	Emission Rate (g/sec)
Criteria Pollutants		
Sulfur Oxides	TF5W	1.77E-03
	TF6W	1.77E-03
	TA1W	7.18E-03
	TA2W	3.77E-02
	TA3W	7.18E-03
	TA1E	7.18E-03
	TA2E	7.18E-03
	PROC	2.13E-01
Carbon Monoxide	TF5W	3.72E-02
	TF6W	3.72E-02
	TA1W	9.69E-02
	TA2W	0.510
	TA3W	9.69E-02
	TA1E	9.69E-02
	TA2E	9.69E-02
	PROC	1.60E+02
Nitrogen Dioxide	TF5W	1.46E-01
	TF6W	1.46E-01
	TA1W	3.15E-01
	TA2W	1.66
	TA3W	3.15E-01
	TA1E	3.15E-01
	TA2E	3.15E-01
	PROC	1.6E+01
PM-10	TF5W	1.03E-02
	TF6W	1.03E-02
	TA1W	7.40E-02
	TA2W	3.88E-01
	TA3W	7.40E-02
	TA1E	7.40E-02
	TA2E	7.40E-02
	PROC	6.67E+00
	BTCH	3.17E+00
Hazardous Air Pollutants		
Formaldehyde	TF5W	3.61E-05
	TF6W	3.61E-05
	TA1W	9.33E-05
	TA2W	4.89E-04
	TA3W	9.33E-05
	TA1E	9.33E-05
	TA2E	9.33E-05
	PROC	3.98E-04

Notes:

g/sec = Grams per second

Routine emissions from tank farms and evaporator would occur as shown in Table G.3.1.2

Table G.3.1.18 Emission Rates for the Phased Implementation Alternative Phase 2 - Operation Phase

Pollutant	Source	Emission Rates (g/sec)
Criteria Pollutants		
Sulfur Oxides	SSPI	1.36E-01
	NSPI	2.34E-01
	TF5W, TF6W	1.77E-03
	ST-H	1.65E-02
Carbon Monoxide	ST-L	6.99E-01
	SSPI	2.27E+00
	NSPI	3.78E+00
	TF5W, TF6W	3.72E-02
Nitrogen Dioxide	ST-H	7.28E-01
	ST-L	7.86E+00
	SSPI	9.59E-02
	NSPI	1.61E-01
PM-10	TF5W, TF6W	1.46E-01
	ST-H	1.57E-02
	ST-L	4.75E-01
	SSPI	6.22E-03
	NSPI	1.29E-02
	TF5W, TF6W	1.03E-02
Hazardous Air Pollutants		
Formaldehyde	TF5W, TF6W	3.61E-05
Arsenic Compounds	ST-H	1.10E-09
	ST-L	8.14E-10
Beryllium Compounds	ST-H	2.80E-11
	ST-L	5.83E-12
Cadmium Compounds	ST-H	1.05E-08
	ST-L	7.03E-09
Cobalt Compounds	ST-H	1.18E-09
	ST-L	2.04E-10
Chromium Compounds	SSPI	4.79E-08
	NSPI	8.88E-08
	ST-H	5.92E-08
Manganese Compounds	ST-L	5.27E-07
	SSPI	4.62E-09
	NSPI	3.70E-08
	ST-H	2.10E-07
Lead Compounds	ST-L	6.01E-08
	ST-H	3.71E-08
Antimony Compounds	ST-L	8.70E-09
	ST-H	2.65E-09
Selenium Compounds	ST-L	2.13E-10
	ST-H	3.23E-09
Nickel Compounds	ST-L	2.50E-09
	SSPI	1.33E-09
	NSPI	3.70E-09
Hydrogen Chloride	ST-H	2.1E-04
	ST-L	2.96E-09
	SSPI	1.07E-03
	NSPI	1.79E-03
Iodine	ST-H	6.96E-03
	ST-L	8.88E-03
Ammonia	ST-H	7.26E-06
	ST-L	1.29E-03
	SSPI	1.08E-02
Silver Oxide	NSPI	2.62E-02
	ST-H	0.000
	ST-L	1.04E-01
Boric Oxide	ST-H	4.82E-10
	ST-L	1.02E-10
	ST-H	3.19E-06
	ST-L	1.23E-04

Table G.3.1.18 Emission Rates for the Phased Implementation Alternative Phase 2 - Operation Phase (cont'd)

Pollutant	Source	Emission Rate (g/sec)
Calcium Oxide	ST-H	0
	ST-L	8.88E-06
Ferric Oxide	ST-H	1.27E-06
	ST-L	3.70E-08
Magnesium Oxide	ST-H	9.48E-09
	ST-L	8.79E-06
Tellurium Trioxide	ST-H	3.71E-10
	ST-L	1.94E-11
Uranium Trioxide	ST-H	1.69E-06
	ST-L	2.68E-07
Vanadium Pentoxide	ST-H	7.56E-11
	ST-L	4.81E-11
Zinc Oxide	ST-H	2.00E-09
	ST-L	3.05E-09
Zirconium Oxide	ST-H	8.16E-07
	ST-L	5.27E-08
Fluoride	SSPI	3.92E-02
	NSPI	6.69E-02
	ST-H	1.63E-02
	ST-L	2.07E-02
Nitric Acid	SSPI	8.88E-03
	NSPI	2.37E-02
	ST-H	3.04E-03
	ST-L	3.87E-03
Barium Oxide	ST-H	2.50E-09
	ST-L	9.25E-10

Notes:

g/sec = Grams per second

In addition, routine and retrieval emissions from tank farms and evaporator would occur as shown in Table G.3.1.3.

Table G.3.1.19 Radionuclide Emission Rates for the No Action Alternative (Tank Waste)

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF6W	8E-09	--	--	--	--
Cs-137	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	8.2E-08	WESF	2.6E-06
I-129	TF6E	2.3E-05	TF7E	2.3E-05	--	--
Pu-239	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	8.1E-09	TF6W	2.4E-07
	EVAP	1.4E-04	WESF	2.4E-07	--	--
Sr-90	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	3.1E-06
	TF6W	9.1E-08	EVAP	8.0E-05	WESF	5.1E-06

Notes:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Table G.3.1.20 Radionuclide Emission Rates for the Long-Term Management Alternative Phase 1

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF6W	3.2E-03	--	--	--	--
Cs-137	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	8.2E-08	TF6W	3.1E-03
	WESF	2.6E-06	--	--	--	--
I-129	TF6E	2.3E-05	TF7E	2.3E-05	TF6W	6.9E-05
Pu-239	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	8.1E-09	TF6W	3.0E-03
	EVAP	1.4E-04	WESF	2.4E-07	--	--
Sr-90	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	3.1E-06
	TF6W	2.1E-01	EVAP	8.0E-05	WESF	5.1E-06

Notes:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Table G.3.1.21 Radionuclide Emission Rates for the Long-Term Management Alternative Phase 2

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	PROC	1.6E-03	--	--	--	--
Cs-137	PROC	2.0E-03	WESF	2.6E-06	--	--
I-129	PROC	5.0E-05	--	--	--	--
Pu-239	PROC	1.4E-03	EVAP	1.4E-04	WESF	2.4E-07
Sr-90	PROC	8.1E-02	EVAP	8.0E-05	WESF	5.1E-06

Notes:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Table G.3.1.22 Radionuclide Emission Rates for the In Situ Fill and Cap Alternative

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF5W	1.7E-03	TF6W	1.7E-03	--	--
Cs-137	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	1.6E-03	TF6W	1.6E-03
	WESF	2.6E-06	--	--	--	--
I-129	TF6E	2.3E-05	TF7E	2.3E-05	TF5W	3.7E-05
	TF6W	3.7E-05	--	--	--	--
Pu-239	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	1.6E-03	TF6W	1.6E-03
	EVAP	1.4E-04	WESF	2.4E-07	--	--
Sr-90	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	1.1E-01
	TF6W	1.1E-01	EVAP	8.0E-05	WESF	5.1E-06

Notes:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Table G.3.1.23 Radionuclide Emission Rates for the In Situ Vitrification Alternative

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF6W	8.0E-09	IS6W	2.0E-07	--	--
C-14	IS6W	1.1E+03	--	--	--	--
Cs-137	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	8.2E-08	IS6W	7.0E-05
	WESF	2.6E-06	--	--	--	--
I-129	TF6E	2.3E-05	TF7E	2.3E-05	IS6W	3.2E-00
Pu-239	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	8.1E-09	TF6W	2.4E-07
	IS6W	6.6E-08	EVAP	1.4E-04	WESF	2.4E-07
Ru-106	IS6W	7.6E-14	--	--	--	--
Sm-151	IS6W	1.3E-06	--	--	--	--
Sr-90	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	3.1E-06
	TF6W	9.1E-08	IS6W	1.4E-04	EVAP	8.0E-05
	WESF	5.1E-06	--	--	--	--
Zr-93	IS6W	7.8E-09	--	--	--	--

Notes:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Table G.3.1.24 Radionuclide Emission Rates for the Ex Situ Intermediate Separations Alternative

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF6W	3.2E-03	STH	2.1E-03	--	--
Cs-137	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	8.2E-08	TF6W	3.1E-03
	STH	1.5E-00	WESF	2.6E-06	--	--
I-129	TF6E	2.3E-05	TF7E	2.3E-05	TF6W	6.9E-05
	STL	8.4E-01	--	--	--	--
Pu-239	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	8.1E-09	TF6W	3.0E-03
	STH	2.3E-03	EVAP	1.4E-04	WESF	2.4E-07
Sr-90	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	3.1E-06
	TF6W	2.1E-01	IS6W	1.4E-04	EVAP	8.0E-05
	WESF	5.1E-06	--	--	--	--
Tc-99	STH	1.3E-04	--	--	--	--

Note:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Emission rates shown are for the operational phase of the alternative. Emission rates for the construction phase are the same as those shown for the No Action alternative (tank waste) (Table G.3.1.19). No radionuclides will be emitted from the construction areas.

Table G.3.1.25 Radionuclide Emission Rates for the Ex Situ No Separations Alternative

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF6W	3.2E-03	SMIN	3.8E-03	--	--
C-14	SMIN	3.8E-02	--	--	--	--
Cs-137	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	8.2E-08	TF6W	3.1E-03
	SMIN	2.5E-00	WESF	2.6E-06	--	--
I-129	TF6E	2.3E-05	TF7E	2.3E-05	TF6W	6.9E-05
	SMIN	1.1E-00	--	--	--	--
Pu-239	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	8.1E-09	TF6W	3.0E-03
	SMIN	3.9E-03	EVAP	1.4E-04	WESF	2.4E-07
Sr-90	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	3.1E-06
	TF6W	2.1E-01	SMIN	3.9E-00	EVAP	8.0E-05
	WESF	5.1E-06	--	--	--	--
Tc-99	SMIN	1.2E-03	--	--	--	--

Note:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Emission rates shown are for the operational phase of the alternative. Emission rates for the construction phase are the same as those shown for the No Action alternative (tank waste) (Table G.3.1.19). No radionuclides will be emitted from the construction areas.

Table G.3.1.26 Radionuclide Emission Rates for the Ex Situ Extensive Separations Alternative

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF6W	3.2E-03	ESEP	2.7E-03	--	--
C-14	ESEP	2.8E-02	--	--	--	--
Cs-137	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	8.2E-08	TF6W	3.1E-03
	ESEP	8.9E-01	WESF	2.6E-06	--	--
I-129	TF6E	2.3E-05	TF7E	2.3E-05	TF6W	6.9E-05
	ESEP	8.9E-01	--	--	--	--
Pu-239	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	8.1E-09	TF6W	3.0E-03
	EVAP	1.4E-04	ESEP	8.4E-04	WESF	2.4E-07
Ru-106	ESEP	1.0E-09	--	--	--	--
Sm-151	ESEP	1.7E-02	--	--	--	--
Sr-90	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	3.1E-06
	TF6W	2.1E-01	EVAP	8.0E-05	ESEP	1.4E-00
	WESF	5.1E-06	--	--	--	--
Tc-99	ESEP	8.4E-04	--	--	--	--
Zr-93	ESEP	1.1E-04	--	--	--	--

Note:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Emission rates shown are for the operational phase of the alternative. Emission rates for the construction phase are the same as those shown for the No Action alternative (tank waste) (Table G.3.1.19). No radionuclides will be emitted from the construction areas.

Table G.3.1.27 Radionuclide Emission Rates for the Ex Situ/In Situ Combination Alternative

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF5W	1.7E-03	TF6W	1.7E-03	STL	1.9E-03
C-14	STL	2.7E-02	--	--	--	--
Cs-137	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	1.6E-03	TF6W	1.6E-03
	STL	1.3E-00	WESF	2.6E-06	--	--
I-129	TF6E	2.3E-05	TF7E	2.3E-05	TF5W	3.6E-05
	TF6W	3.6E-05	STL	7.6E-01	--	--
Pu-239	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	1.6E-03	TF6W	1.6E-03
	STL	2.1E-03	EVAP	1.4E-04	WESF	2.4E-07
Sr-90	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	1.1E-01
	TF6W	1.1E-01	STL	2.1E-00	EVAP	8.0E-05
	WESF	5.1E-06	--	--	--	--
Tc-99	STL	1.2E-04	--	--	--	--

Note:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Emission rates shown are for the operational phase of the alternative. Emission rates for the construction phase are the same as those shown for the No Action alternative (tank waste) (Table G.3.1.19). No radionuclides will be emitted from the construction areas.

Table G.3.1.28 Radionuclide Emission Rates for the Phased Implementation Alternative Phase 1

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF6W	8E-09	SSPI	3.26E-07	NSPI	2.40E-04
C-14	SSPI	4.0E+01	NSPI	7.0E+01	--	--
Cs-137	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	8.2E-08	WESF	2.60E-06
	SSPI	1.87E-03	NSPI	1.73E-01	--	--
Pu-239	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	8.1E-09	TF6W	2.4E-07
	EVAP	1.4E-04	WESF	2.4E-07	SSPI	7.90E-08
	NSPI	2.63E-04	--	--	--	--
Sr-90	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	3.1E-06
	TF6W	9.1E-08	EVAP	8.0E-05	WESF	5.1E-06
	SSPI	7.20E-05	NSPI	2.67E-01	--	--
Tc-99	SSPI	9.83E-07	--	--	--	--

Notes:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Table G.3.1.29 Radionuclide Emission Rates for the Phased Implementation Alternative Phase 2

Radionuclide	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)	Source	Emission Rate (Ci/yr)
Am-241	SSPI	3.26E-07	NSPI	2.40E-04	--	--
	TF1W	7.6E-08	TF2W	4.0E-04	TF4W	1.1E-03
	TF6W	3.2E-03	STH	1.25E-03	--	--
C-14	STL	2.60E+02	SSPI	4.0E+01	NSPI	7.0E+01
Cs-137	SSPI	1.87E-03	NSPI	1.73E-01	--	--
	TF1E	2.4E-05	TF2E	2.1E-04	TF3E	9.1E-05
	TF6E	2.7E-05	TF7E	2.7E-05	TF8E	2.4E-05
	TF9E	2.9E-05	TF10E	2.8E-08	TF2W	4.3E-04
	TF4W	1.0E-03	TF5W	8.2E-08	TF6W	3.1E-03
	STH	8.88E-01	WESF	2.6E-06	--	--
I-129	TF6E	2.3E-05	TF7E	2.3E-05	TF6W	6.9E-05
	STL	7.79E-01	--	--	--	--
Pu-239	SSPI	7.90E-08	NSPI	2.63E-04	--	--
	TF6E	2.9E-09	TF7E	2.9E-09	TF10E	1.5E-08
	TF1W	2.3E-08	TF2W	2.3E-04	TF3W	7.1E-05
	TF4W	1.0E-03	TF5W	8.1E-09	TF6W	3.0E-03
	STH	1.38E-03	EVAP	1.4E-04	WESF	2.4E-07
Sr-90	SSPI	7.20E-05	NSPI	2.67E-01	--	--
	TF1E	2.4E-05	TF2E	5.4E-06	TF3E	2.5E-03
	TF4E	2.5E-05	TF5E	1.2E-07	TF6E	4.1E-06
	TF7E	4.1E-06	TF8E	6.7E-04	TF9E	8.3E-04
	TF10E	1.6E-07	TF11E	6.6E-08	TF2W	2.4E-04
	TF3W	7.0E-02	TF4W	1.1E-03	TF5W	3.1E-06
	TF6W	2.1E-01	IS6W	1.4E-04	EVAP	8.0E-05
	WESF	5.1E-06	STH	1.39E+00	--	--
Tc-99	STH	7.80E-05	SSPI	9.83E-07	--	--

Note:

Ci/yr = Curie per year

-- indicates no additional sources or emission rates.

Emission rates shown are for the operational phase of the alternative. Emission rates for the construction phase are the same as those shown for the No Action alternative (tank waste) (Table G.3.1.19). No radionuclides will be emitted from the construction areas.

Table G.3.1.30 Matrix of Wind Speed and Stability Classes

Wind Speed and Stability Class Combinations Used for the ISCLT2 Model													
Stability Class	10-Meter Wind Speed (Meters Per Second)												
	1	1.5	2	2.5	3	3.5	4	4.5	5	8	10	15	20
A	*	*	*	*	*								
B	*	*	*	*	*	*	*	*	*				
C	*	*	*	*	*	*	*	*	*	*	*		
D	*	*	*	*	*	*	*	*	*	*	*	*	*
E	*	*	*	*	*	*	*	*	*				
F	*	*	*	*	*	*	*						

Table G.3.1.31 Stability Array for Year 1989

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
N	A	4.10E-03	2.30E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00
NNE	A	3.20E-03	4.00E-04	6.00E-04	2.00E-04	0.00E+00	0.00E+00
NE	A	3.30E-03	6.00E-04	4.00E-04	2.00E-04	0.00E+00	0.00E+00
ENE	A	3.60E-03	4.00E-04	1.00E-04	2.00E-04	0.00E+00	0.00E+00
E	A	4.00E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ESE	A	1.20E-03	8.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	A	2.20E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	A	7.00E-04	0.00E+00	4.00E-04	0.00E+00	0.00E+00	0.00E+00
S	A	1.20E-03	1.00E-04	0.00E+00	1.00E-04	0.00E+00	0.00E+00
SSW	A	5.00E-04	4.00E-04	4.00E-04	5.00E-04	0.00E+00	0.00E+00
SW	A	4.00E-04	5.00E-04	5.00E-04	7.00E-04	0.00E+00	0.00E+00
WSW	A	2.00E-04	5.00E-04	7.00E-04	7.00E-04	1.00E-04	0.00E+00
W	A	1.20E-03	6.00E-04	6.00E-04	7.00E-04	0.00E+00	0.00E+00
WNW	A	1.50E-03	1.80E-03	1.00E-04	2.00E-04	0.00E+00	0.00E+00
NW	A	1.30E-03	5.00E-03	1.50E-03	1.10E-03	4.00E-04	0.00E+00
NNW	A	1.50E-03	2.80E-03	1.00E-04	4.00E-04	0.00E+00	0.00E+00
N	B	2.20E-03	1.10E-03	2.00E-04	0.00E+00	1.00E-04	0.00E+00
NNE	B	7.00E-04	6.00E-04	6.00E-04	4.00E-04	0.00E+00	0.00E+00
NE	B	9.00E-04	1.00E-04	4.00E-04	0.00E+00	0.00E+00	0.00E+00
ENE	B	7.00E-04	4.00E-04	1.00E-04	0.00E+00	1.00E-04	0.00E+00
E	B	7.00E-04	5.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ESE	B	6.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	B	8.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	B	5.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S	B	2.00E-04	5.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSW	B	2.00E-04	1.00E-04	1.00E-04	1.00E-04	1.00E-04	1.00E-04
SW	B	4.00E-04	4.00E-04	7.00E-04	2.00E-04	1.00E-04	0.00E+00
WSW	B	2.00E-04	2.00E-04	5.00E-04	1.40E-03	1.00E-04	0.00E+00
W	B	4.00E-04	4.00E-04	6.00E-04	2.00E-04	1.00E-04	0.00E+00
WNW	B	9.00E-04	1.10E-03	2.00E-04	2.00E-04	0.00E+00	0.00E+00
NW	B	6.00E-04	4.00E-03	1.50E-03	8.00E-04	1.00E-04	0.00E+00
NNW	B	1.20E-03	1.50E-03	1.30E-03	2.00E-04	0.00E+00	0.00E+00
N	C	9.00E-04	8.00E-04	5.00E-04	0.00E+00	0.00E+00	0.00E+00
NNE	C	1.10E-03	1.20E-03	7.00E-04	1.00E-04	1.00E-04	0.00E+00

Table G.3.1.31 Stability Array for Year 1989 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
NE	C	1.10E-03	9.00E-04	5.00E-04	1.00E-04	0.00E+00	0.00E+00
ENE	C	7.00E-04	1.00E-04	0.00E+00	1.00E-04	0.00E+00	0.00E+00
E	C	6.00E-04	7.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ESE	C	1.20E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	C	1.50E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	C	1.20E-03	5.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
S	C	8.00E-04	1.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	C	6.00E-04	9.00E-04	4.00E-04	1.00E-04	1.00E-04	0.00E+00
SW	C	6.00E-04	6.00E-04	1.10E-03	1.00E-04	5.00E-04	0.00E+00
WSW	C	7.00E-04	5.00E-04	1.80E-03	1.10E-03	5.00E-04	0.00E+00
W	C	1.20E-03	5.00E-04	1.10E-03	2.00E-04	1.00E-04	0.00E+00
WNW	C	1.40E-03	9.00E-04	2.00E-04	1.00E-04	0.00E+00	0.00E+00
NW	C	1.10E-03	2.80E-03	1.80E-03	2.00E-04	1.00E-04	0.00E+00
NNW	C	1.80E-03	1.30E-03	5.00E-04	1.00E-04	0.00E+00	0.00E+00
N	D	1.55E-02	1.37E-02	4.00E-03	5.00E-04	0.00E+00	0.00E+00
NNE	D	1.08E-02	7.40E-03	2.00E-03	1.10E-03	2.00E-04	0.00E+00
NE	D	1.08E-02	3.50E-03	1.30E-03	1.00E-04	0.00E+00	0.00E+00
ENE	D	7.70E-03	2.20E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00
E	D	1.22E-02	3.50E-03	4.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	D	6.60E-03	2.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	D	7.90E-03	2.50E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	D	5.20E-03	2.70E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00
S	D	7.50E-03	2.50E-03	1.20E-03	5.00E-04	0.00E+00	0.00E+00
SSW	D	4.20E-03	3.90E-03	2.20E-03	1.20E-03	9.00E-04	0.00E+00
SW	D	5.50E-03	2.80E-03	3.20E-03	4.10E-03	2.60E-03	4.00E-04
WSW	D	3.30E-03	5.20E-03	5.60E-03	5.00E-03	1.30E-03	1.00E-04
W	D	7.10E-03	8.10E-03	3.70E-03	1.90E-03	4.00E-04	0.00E+00
WNW	D	5.70E-03	7.40E-03	4.00E-03	1.20E-03	1.00E-04	0.00E+00
NW	D	8.60E-03	1.39E-02	9.60E-03	4.00E-03	1.10E-03	0.00E+00
NNW	D	9.10E-03	1.38E-02	3.70E-03	1.10E-03	0.00E+00	0.00E+00
N	E	8.10E-03	4.20E-03	1.20E-03	2.00E-04	0.00E+00	0.00E+00
NNE	E	4.20E-03	1.30E-03	1.40E-03	3.70E-03	1.10E-03	0.00E+00
NE	E	2.60E-03	6.00E-04	8.00E-04	1.10E-03	4.00E-04	0.00E+00
ENE	E	3.30E-03	9.00E-04	4.00E-04	1.00E-04	0.00E+00	0.00E+00
E	E	5.30E-03	2.60E-03	0.00E+00	1.00E-04	0.00E+00	0.00E+00
ESE	E	4.10E-03	1.50E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table G.3.1.31 Stability Array for Year 1989 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
SE	E	5.00E-03	3.00E-03	7.00E-04	1.00E-04	0.00E+00	0.00E+00
SSE	E	5.70E-03	3.70E-03	9.00E-04	0.00E+00	0.00E+00	0.00E+00
S	E	6.70E-03	4.90E-03	1.60E-03	6.00E-04	2.00E-04	0.00E+00
SSW	E	3.20E-03	3.30E-03	1.50E-03	7.00E-04	5.00E-04	0.00E+00
SW	E	6.00E-03	4.20E-03	4.10E-03	5.90E-03	1.10E-03	0.00E+00
WSW	E	4.90E-03	7.30E-03	8.10E-03	2.90E-03	6.00E-04	0.00E+00
W	E	1.07E-02	2.01E-02	1.39E-02	2.30E-03	2.00E-04	0.00E+00
WNW	E	8.40E-03	1.97E-02	1.97E-02	7.50E-03	1.00E-04	0.00E+00
NW	E	7.00E-03	1.63E-02	1.76E-02	9.40E-03	9.00E-04	0.00E+00
NNW	E	8.10E-03	7.60E-03	1.60E-03	2.00E-04	0.00E+00	0.00E+00
N	F	5.70E-03	2.20E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NNE	F	3.00E-03	9.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
NE	F	2.10E-03	5.00E-04	5.00E-04	1.00E-04	0.00E+00	0.00E+00
ENE	F	2.10E-03	4.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E	F	4.10E-03	4.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ESE	F	4.10E-03	8.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	F	3.60E-03	4.80E-03	4.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	F	4.10E-03	6.10E-03	4.00E-04	2.00E-04	0.00E+00	0.00E+00
S	F	8.00E-03	6.30E-03	4.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	F	5.50E-03	4.90E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00
SW	F	6.70E-03	7.30E-03	1.30E-03	0.00E+00	0.00E+00	0.00E+00
WSW	F	5.90E-03	1.86E-02	2.00E-03	1.00E-04	0.00E+00	0.00E+00
W	F	1.02E-02	3.51E-02	3.90E-03	0.00E+00	0.00E+00	0.00E+00
WNW	F	8.10E-03	2.57E-02	3.60E-03	0.00E+00	0.00E+00	0.00E+00
NW	F	5.90E-03	2.19E-02	4.70E-03	0.00E+00	0.00E+00	0.00E+00
NNW	F	6.00E-03	8.40E-03	4.00E-04	0.00E+00	0.00E+00	0.00E+00

Notes:

Dir = wind direction

Stab = stability class

ws1 = wind speed category 1 (1.50 m/sec)

ws2 = wind speed category 2 (2.50 m/sec)

ws3 = wind speed category 3 (4.30 m/sec)

ws4 = wind speed category 4 (6.80 m/sec)

ws5 = wind speed category 5 (9.50 m/sec)

ws6 = wind speed category 6 (12.50 m/sec)

Table G.3.1.32 Stability Array for Year 1990

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
N	A	1.40E-03	1.40E-03	8.00E-04	8.00E-04	0.00E+00	0.00E+00
NNE	A	8.00E-04	5.00E-04	1.00E-04	6.00E-04	0.00E+00	0.00E+00
NE	A	1.20E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ENE	A	5.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E	A	8.00E-04	1.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ESE	A	1.40E-03	1.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	A	1.20E-03	1.40E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	A	4.00E-04	9.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S	A	7.00E-04	2.00E-04	1.00E-04	6.00E-04	0.00E+00	0.00E+00
SSW	A	1.00E-04	4.00E-04	9.00E-04	5.00E-04	5.00E-04	0.00E+00
SW	A	4.00E-04	1.00E-04	6.00E-04	1.40E-03	2.20E-03	1.30E-03
WSW	A	1.00E-04	4.00E-04	4.00E-04	2.10E-03	9.00E-04	6.00E-04
W	A	7.00E-04	2.00E-04	1.50E-03	1.30E-03	6.00E-04	0.00E+00
WNW	A	0.00E+00	5.00E-04	1.30E-03	8.00E-04	2.00E-04	0.00E+00
NW	A	0.00E+00	2.20E-03	3.40E-03	2.50E-03	5.00E-04	0.00E+00
NNW	A	4.00E-04	1.80E-03	1.80E-03	7.00E-04	0.00E+00	0.00E+00
N	B	9.00E-04	1.30E-03	7.00E-04	2.00E-04	1.00E-04	0.00E+00
NNE	B	8.00E-04	6.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
NE	B	7.00E-04	5.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ENE	B	5.00E-04	1.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
E	B	1.10E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ESE	B	5.00E-04	8.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	B	7.00E-04	5.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	B	4.00E-04	1.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
S	B	1.00E-04	4.00E-04	1.00E-04	2.00E-04	1.00E-04	0.00E+00
SSW	B	1.00E-04	1.00E-04	4.00E-04	2.00E-04	1.00E-04	0.00E+00
SW	B	2.00E-04	4.00E-04	8.00E-04	1.10E-03	5.00E-04	5.00E-04
WSW	B	0.00E+00	0.00E+00	5.00E-04	9.00E-04	1.30E-03	1.00E-04
W	B	0.00E+00	1.00E-04	5.00E-04	2.00E-04	0.00E+00	2.00E-04
WNW	B	1.00E-04	4.00E-04	1.00E-04	8.00E-04	0.00E+00	0.00E+00
NW	B	5.00E-04	4.00E-04	1.90E-03	1.60E-03	2.00E-04	0.00E+00
NNW	B	2.00E-04	7.00E-04	5.00E-04	2.00E-04	0.00E+00	0.00E+00
N	C	2.20E-03	3.20E-03	7.00E-04	7.00E-04	1.00E-04	0.00E+00
NNE	C	1.80E-03	1.80E-03	4.00E-04	1.00E-04	0.00E+00	0.00E+00
NE	C	1.30E-03	7.00E-04	0.00E+00	5.00E-04	0.00E+00	0.00E+00
ENE	C	9.00E-04	1.10E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
E	C	1.40E-03	9.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00

Table G.3.1.32 Stability Array for Year 1990 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
ESE	C	1.60E-03	1.10E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	C	1.10E-03	1.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	C	1.00E-04	5.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
S	C	5.00E-04	7.00E-04	5.00E-04	6.00E-04	1.00E-04	0.00E+00
SSW	C	4.00E-04	6.00E-04	5.00E-04	5.00E-04	4.00E-04	0.00E+00
SW	C	4.00E-04	0.00E+00	1.10E-03	1.20E-03	7.00E-04	7.00E-04
WSW	C	1.00E-04	4.00E-04	1.20E-03	1.40E-03	1.00E-04	1.00E-04
W	C	0.00E+00	1.00E-04	5.00E-04	5.00E-04	2.00E-04	4.00E-04
WNW	C	4.00E-04	4.00E-04	5.00E-04	5.00E-04	0.00E+00	0.00E+00
NW	C	4.00E-04	1.20E-03	1.90E-03	1.50E-03	2.00E-04	0.00E+00
NNW	C	8.00E-04	1.90E-03	4.00E-04	2.00E-04	0.00E+00	0.00E+00
N	D	1.08E-02	1.58E-02	3.00E-03	1.60E-03	2.00E-04	4.00E-04
NNE	D	8.10E-03	9.20E-03	1.30E-03	5.00E-04	4.00E-04	0.00E+00
NE	D	6.70E-03	6.10E-03	5.00E-04	4.00E-04	4.00E-04	0.00E+00
ENE	D	6.20E-03	3.90E-03	9.00E-04	2.00E-04	0.00E+00	0.00E+00
E	D	7.80E-03	6.20E-03	9.00E-04	1.00E-04	0.00E+00	0.00E+00
ESE	D	5.10E-03	4.70E-03	4.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	D	6.40E-03	6.00E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	D	3.20E-03	4.30E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00
S	D	4.80E-03	3.00E-03	1.30E-03	8.00E-04	2.00E-04	1.00E-04
SSW	D	3.00E-03	3.40E-03	1.90E-03	2.60E-03	2.30E-03	2.30E-03
SW	D	3.20E-03	5.10E-03	3.70E-03	6.20E-03	4.20E-03	2.60E-03
WSW	D	2.90E-03	5.40E-03	8.60E-03	5.80E-03	2.50E-03	1.30E-03
W	D	4.60E-03	7.20E-03	7.80E-03	6.10E-03	6.00E-04	1.20E-03
WNW	D	3.30E-03	5.50E-03	4.00E-03	2.80E-03	5.00E-04	0.00E+00
NW	D	4.20E-03	1.27E-02	1.16E-02	6.80E-03	2.30E-03	1.00E-04
NNW	D	7.20E-03	1.46E-02	5.50E-03	1.30E-03	2.00E-04	0.00E+00
N	E	6.00E-03	6.40E-03	1.10E-03	0.00E+00	0.00E+00	0.00E+00
NNE	E	3.20E-03	4.10E-03	1.30E-03	4.00E-04	1.00E-04	0.00E+00
NE	E	3.30E-03	2.10E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
ENE	E	2.90E-03	1.20E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
E	E	3.50E-03	4.30E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	E	2.80E-03	2.70E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	E	3.70E-03	2.50E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	E	3.00E-03	5.40E-03	1.10E-03	1.00E-04	0.00E+00	0.00E+00
S	E	3.40E-03	5.40E-03	1.20E-03	4.00E-04	5.00E-04	0.00E+00
SSW	E	3.40E-03	2.20E-03	2.30E-03	1.20E-03	1.10E-03	7.00E-04

Table G.3.1.32 Stability Array for Year 1990 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
SW	E	3.90E-03	4.90E-03	3.40E-03	2.00E-03	1.20E-03	6.00E-04
WSW	E	4.40E-03	9.20E-03	6.50E-03	3.20E-03	1.30E-03	6.00E-04
W	E	5.10E-03	2.31E-02	2.04E-02	4.30E-03	8.00E-04	1.00E-04
WNW	E	5.30E-03	1.87E-02	1.89E-02	9.30E-03	1.30E-03	0.00E+00
NW	E	6.10E-03	1.23E-02	1.80E-02	1.78E-02	5.40E-03	4.00E-04
NNW	E	4.70E-03	1.07E-02	3.00E-03	2.00E-04	0.00E+00	0.00E+00
N	F	4.60E-03	3.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NNE	F	2.00E-03	1.90E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
NE	F	1.80E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ENE	F	2.50E-03	7.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
E	F	3.00E-03	1.80E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	F	2.00E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	F	3.40E-03	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	F	3.40E-03	5.00E-03	1.30E-03	2.00E-04	0.00E+00	0.00E+00
S	F	3.70E-03	6.90E-03	8.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	F	3.50E-03	6.40E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00
SW	F	4.40E-03	8.50E-03	8.00E-04	0.00E+00	0.00E+00	0.00E+00
WSW	F	5.40E-03	2.07E-02	5.50E-03	0.00E+00	0.00E+00	0.00E+00
W	F	5.60E-03	3.85E-02	6.20E-03	1.00E-04	0.00E+00	0.00E+00
WNW	F	3.90E-03	2.11E-02	9.30E-03	1.00E-04	0.00E+00	0.00E+00
NW	F	3.70E-03	1.47E-02	1.51E-02	8.00E-04	0.00E+00	0.00E+00
NNW	F	4.00E-03	7.70E-03	1.20E-03	0.00E+00	0.00E+00	0.00E+00

Notes:

Dir = wind direction

Stab = stability class

ws1 = wind speed category 1 (1.50 m/sec)

ws2 = wind speed category 2 (2.50 m/sec)

ws3 = wind speed category 3 (4.30 m/sec)

ws4 = wind speed category 4 (6.80 m/sec)

ws5 = wind speed category 5 (9.50 m/sec)

ws6 = wind speed category 6 (12.50 m/sec)

Table G.3.1.33 Stability Array for Year 1991

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
N	A	1.20E-03	7.10E-03	2.60E-03	3.00E-04	0.00E+00	0.00E+00
NNE	A	1.70E-03	4.90E-03	2.90E-03	1.60E-03	1.00E-04	0.00E+00
NE	A	1.90E-03	3.50E-03	1.00E-03	2.00E-04	0.00E+00	0.00E+00
ENE	A	1.60E-03	3.10E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
E	A	2.70E-03	3.50E-03	3.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	A	7.00E-04	1.40E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	A	7.00E-04	9.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	A	1.20E-03	1.20E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
S	A	1.00E-03	9.00E-04	3.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	A	5.00E-04	7.00E-04	6.00E-04	3.00E-04	0.00E+00	0.00E+00
SW	A	2.00E-04	8.00E-04	1.40E-03	1.00E-03	0.00E+00	0.00E+00
WSW	A	2.00E-04	1.00E-03	1.20E-03	2.10E-03	1.70E-03	5.00E-04
W	A	5.00E-04	1.00E-03	3.00E-03	2.00E-03	8.00E-04	0.00E+00
WNW	A	1.00E-04	8.00E-04	9.00E-04	9.00E-04	1.00E-04	0.00E+00
NW	A	2.00E-04	1.30E-03	6.00E-03	5.80E-03	1.70E-03	1.00E-04
NNW	A	5.00E-04	3.40E-03	3.90E-03	2.20E-03	5.00E-04	0.00E+00
N	B	2.80E-03	4.80E-03	1.00E-03	1.00E-04	0.00E+00	0.00E+00
NNE	B	2.10E-03	2.90E-03	8.00E-04	1.00E-04	0.00E+00	0.00E+00
NE	B	2.20E-03	1.70E-03	8.00E-04	2.00E-04	0.00E+00	0.00E+00
ENE	B	2.20E-03	1.30E-03	3.00E-04	0.00E+00	0.00E+00	0.00E+00
E	B	2.40E-03	3.40E-03	3.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	B	1.20E-03	2.30E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	B	1.00E-03	9.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	B	5.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S	B	5.00E-04	6.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	B	5.00E-04	3.00E-04	6.00E-04	0.00E+00	0.00E+00	0.00E+00
SW	B	2.00E-04	9.00E-04	5.00E-04	1.00E-04	2.00E-04	0.00E+00
WSW	B	2.00E-04	1.20E-03	6.00E-04	5.00E-04	3.00E-04	0.00E+00
W	B	3.00E-04	6.00E-04	1.90E-03	2.00E-04	2.00E-04	0.00E+00
WNW	B	6.00E-04	1.30E-03	5.00E-04	2.00E-04	0.00E+00	0.00E+00
NW	B	9.00E-04	1.30E-03	2.00E-03	1.60E-03	8.00E-04	0.00E+00
NNW	B	1.50E-03	3.10E-03	2.40E-03	5.00E-04	1.00E-04	1.00E-04
N	C	2.30E-03	6.40E-03	1.00E-03	0.00E+00	0.00E+00	0.00E+00
NNE	C	2.40E-03	2.40E-03	2.00E-04	3.00E-04	1.00E-04	0.00E+00
NE	C	2.90E-03	2.40E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00
ENE	C	3.00E-03	1.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E	C	2.80E-03	2.20E-03	3.00E-04	0.00E+00	0.00E+00	0.00E+00

Table G.3.1.33 Stability Array for Year 1991 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
ESE	C	1.70E-03	1.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	C	7.00E-04	6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	C	8.00E-04	6.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
S	C	7.00E-04	8.00E-04	7.00E-04	2.00E-04	0.00E+00	0.00E+00
SSW	C	8.00E-04	8.00E-04	3.00E-04	1.00E-04	2.00E-04	0.00E+00
SW	C	2.00E-04	1.20E-03	3.00E-04	1.00E-04	5.00E-04	0.00E+00
WSW	C	5.00E-04	3.00E-04	3.00E-04	5.00E-04	2.00E-04	0.00E+00
W	C	1.50E-03	1.50E-03	5.00E-04	5.00E-04	0.00E+00	0.00E+00
WNW	C	1.20E-03	7.00E-04	6.00E-04	1.00E-04	0.00E+00	0.00E+00
NW	C	1.50E-03	3.40E-03	2.20E-03	1.00E-03	3.00E-04	2.00E-04
NNW	C	1.50E-03	5.50E-03	1.60E-03	1.00E-04	0.00E+00	0.00E+00
N	D	1.28E-02	8.80E-03	2.80E-03	3.00E-04	0.00E+00	0.00E+00
NNE	D	7.10E-03	4.20E-03	2.00E-03	2.00E-04	1.00E-04	0.00E+00
NE	D	7.00E-03	1.90E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00
ENE	D	5.90E-03	1.90E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
E	D	5.60E-03	4.30E-03	9.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	D	4.60E-03	3.70E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	D	6.20E-03	2.40E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	D	4.30E-03	2.30E-03	3.00E-04	1.00E-04	0.00E+00	0.00E+00
S	D	3.50E-03	2.40E-03	1.30E-03	7.00E-04	0.00E+00	0.00E+00
SSW	D	2.10E-03	1.00E-03	2.00E-03	1.40E-03	9.00E-04	0.00E+00
SW	D	2.20E-03	1.40E-03	1.90E-03	1.70E-03	1.00E-03	5.00E-04
WSW	D	2.80E-03	2.90E-03	3.10E-03	2.80E-03	1.00E-03	3.00E-04
W	D	6.60E-03	6.20E-03	4.60E-03	2.30E-03	8.00E-04	9.00E-04
WNW	D	5.30E-03	6.40E-03	4.40E-03	2.20E-03	2.00E-04	0.00E+00
NW	D	6.90E-03	1.63E-02	1.43E-02	1.03E-02	4.60E-03	6.00E-04
NNW	D	5.70E-03	1.08E-02	5.30E-03	1.20E-03	5.00E-04	0.00E+00
N	E	4.10E-03	6.50E-03	1.60E-03	6.00E-04	0.00E+00	0.00E+00
NNE	E	3.00E-03	2.20E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
NE	E	1.50E-03	9.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
ENE	E	2.70E-03	7.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
E	E	2.60E-03	3.50E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	E	2.20E-03	2.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	E	4.30E-03	1.70E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	E	3.00E-03	4.60E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
S	E	4.50E-03	3.10E-03	1.70E-03	8.00E-04	1.00E-04	0.00E+00
SSW	E	3.60E-03	3.00E-03	1.20E-03	1.00E-03	3.00E-04	0.00E+00

Table G.3.1.33 Stability Array for Year 1991 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
SW	E	2.40E-03	5.30E-03	2.80E-03	1.60E-03	8.00E-04	1.00E-04
WSW	E	4.00E-03	7.00E-03	6.00E-03	2.90E-03	7.00E-04	1.00E-04
W	E	6.90E-03	2.62E-02	1.51E-02	2.40E-03	2.00E-04	0.00E+00
WNW	E	7.60E-03	2.03E-02	2.17E-02	4.90E-03	6.00E-04	0.00E+00
NW	E	3.70E-03	1.86E-02	2.23E-02	1.64E-02	3.70E-03	2.00E-04
NNW	E	3.50E-03	1.09E-02	5.50E-03	9.00E-04	0.00E+00	0.00E+00
N	F	3.70E-03	2.60E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
NNE	F	2.30E-03	9.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NE	F	1.90E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ENE	F	2.10E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E	F	3.40E-03	1.90E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	F	1.90E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	F	3.00E-03	1.90E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	F	3.30E-03	5.10E-03	1.40E-03	0.00E+00	0.00E+00	0.00E+00
S	F	3.70E-03	7.00E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	F	2.30E-03	4.50E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
SW	F	2.90E-03	7.10E-03	9.00E-04	0.00E+00	0.00E+00	0.00E+00
WSW	F	3.10E-03	1.42E-02	3.60E-03	0.00E+00	0.00E+00	0.00E+00
W	F	6.40E-03	3.32E-02	6.70E-03	2.00E-04	0.00E+00	0.00E+00
WNW	F	3.00E-03	2.58E-02	4.10E-03	0.00E+00	0.00E+00	0.00E+00
NW	F	3.70E-03	2.03E-02	1.24E-02	1.00E-04	0.00E+00	0.00E+00
NNW	F	4.60E-03	1.09E-02	2.90E-03	0.00E+00	0.00E+00	0.00E+00

Notes:

dir = wind direction

stab = stability class

ws1 = wind speed category 1 (1.50 m/sec)

ws2 = wind speed category 2 (2.50 m/sec)

ws3 = wind speed category 3 (4.30 m/sec)

ws4 = wind speed category 4 (6.80 m/sec)

ws5 = wind speed category 5 (9.50 m/sec)

ws6 = wind speed category 6 (12.50 m/sec)

Table G.3.1.34 Stability Array for Year 1992

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
N	A	5.30E-03	1.24E-02	2.20E-03	2.00E-04	0.00E+00	0.00E+00
NNE	A	3.00E-03	6.70E-03	9.00E-04	0.00E+00	0.00E+00	0.00E+00
NE	A	4.70E-03	4.40E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00
ENE	A	4.50E-03	5.70E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E	A	4.60E-03	7.60E-03	5.00E-04	1.00E-04	0.00E+00	0.00E+00
ESE	A	1.60E-03	5.10E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	A	1.30E-03	3.10E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	A	7.00E-04	1.50E-03	3.00E-04	0.00E+00	0.00E+00	0.00E+00
S	A	1.70E-03	7.00E-04	2.00E-04	1.00E-04	0.00E+00	0.00E+00
SSW	A	7.00E-04	1.00E-03	8.00E-04	1.00E-04	0.00E+00	0.00E+00
SW	A	8.00E-04	1.90E-03	1.20E-03	8.00E-04	2.00E-04	0.00E+00
WSW	A	5.00E-04	1.60E-03	3.10E-03	3.40E-03	9.00E-04	1.00E-04
W	A	9.00E-04	1.20E-03	2.90E-03	1.90E-03	1.00E-03	0.00E+00
WNW	A	1.30E-03	1.20E-03	1.00E-03	1.20E-03	0.00E+00	0.00E+00
NW	A	1.00E-03	3.00E-03	4.20E-03	5.80E-03	1.90E-03	1.00E-04
NNW	A	1.40E-03	8.40E-03	6.60E-03	4.90E-03	8.00E-04	1.00E-04
N	B	1.90E-03	5.30E-03	3.00E-04	3.00E-04	0.00E+00	0.00E+00
NNE	B	2.20E-03	1.70E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NE	B	2.10E-03	9.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ENE	B	1.40E-03	1.00E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
E	B	3.80E-03	1.90E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ESE	B	1.40E-03	1.90E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	B	7.00E-04	6.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	B	5.00E-04	8.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
S	B	9.00E-04	7.00E-04	0.00E+00	1.00E-04	0.00E+00	0.00E+00
SSW	B	6.00E-04	2.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
SW	B	3.00E-04	6.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
WSW	B	5.00E-04	2.00E-04	6.00E-04	5.00E-04	2.00E-04	0.00E+00
W	B	6.00E-04	5.00E-04	1.30E-03	3.00E-04	0.00E+00	0.00E+00
WNW	B	1.00E-03	1.00E-04	5.00E-04	1.00E-04	0.00E+00	0.00E+00
NW	B	9.00E-04	1.70E-03	2.00E-03	1.30E-03	5.00E-04	0.00E+00
NNW	B	1.50E-03	4.60E-03	2.30E-03	7.00E-04	1.00E-04	0.00E+00
N	C	3.40E-03	4.90E-03	3.00E-04	1.00E-04	0.00E+00	0.00E+00
NNE	C	1.90E-03	1.20E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
NE	C	2.10E-03	9.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ENE	C	1.20E-03	1.20E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
E	C	1.60E-03	3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table G.3.1.34 Stability Array for Year 1992 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
ESE	C	5.00E-04	9.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	C	5.00E-04	8.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	C	5.00E-04	8.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S	C	3.00E-04	1.00E-04	1.00E-04	1.00E-04	0.00E+00	0.00E+00
SSW	C	2.00E-04	3.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
SW	C	1.00E-04	5.00E-04	2.00E-04	2.00E-04	0.00E+00	0.00E+00
WSW	C	3.00E-04	6.00E-04	1.00E-04	1.30E-03	1.00E-04	1.00E-04
W	C	7.00E-04	2.00E-04	9.00E-04	8.00E-04	1.00E-04	0.00E+00
WNW	C	6.00E-04	1.20E-03	3.00E-04	3.00E-04	0.00E+00	0.00E+00
NW	C	3.00E-04	1.90E-03	1.90E-03	9.00E-04	1.00E-04	0.00E+00
NNW	C	1.00E-03	4.60E-03	1.70E-03	6.00E-04	1.00E-04	0.00E+00
N	D	8.30E-03	9.10E-03	8.00E-04	0.00E+00	0.00E+00	0.00E+00
NNE	D	7.60E-03	3.60E-03	1.00E-04	1.00E-04	0.00E+00	0.00E+00
NE	D	4.70E-03	2.00E-03	2.00E-04	1.00E-04	0.00E+00	0.00E+00
ENE	D	5.70E-03	1.70E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
E	D	7.60E-03	5.70E-03	3.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	D	6.90E-03	2.70E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	D	6.00E-03	2.70E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	D	4.90E-03	2.00E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
S	D	3.80E-03	1.90E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	D	2.30E-03	7.00E-04	2.00E-04	3.00E-04	0.00E+00	0.00E+00
SW	D	1.70E-03	7.00E-04	1.20E-03	5.00E-04	3.00E-04	3.00E-04
WSW	D	1.70E-03	1.20E-03	1.00E-03	2.30E-03	5.00E-04	5.00E-04
W	D	5.00E-03	2.80E-03	6.60E-03	2.30E-03	3.00E-04	0.00E+00
WNW	D	2.70E-03	4.70E-03	6.50E-03	2.70E-03	0.00E+00	0.00E+00
NW	D	3.50E-03	1.27E-02	2.07E-02	1.27E-02	2.30E-03	0.00E+00
NNW	D	6.10E-03	1.53E-02	6.00E-03	3.00E-03	6.00E-04	0.00E+00
N	E	7.20E-03	4.40E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00
NNE	E	3.20E-03	1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NE	E	3.10E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ENE	E	4.20E-03	6.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
E	E	5.20E-03	2.80E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	E	2.40E-03	2.30E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	E	4.40E-03	2.90E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	E	4.60E-03	5.60E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
S	E	4.60E-03	3.60E-03	1.30E-03	1.00E-04	0.00E+00	0.00E+00
SSW	E	3.20E-03	1.50E-03	1.40E-03	7.00E-04	0.00E+00	0.00E+00

Table G.3.1.34 Stability Array for Year 1992 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
SW	E	4.20E-03	2.40E-03	2.20E-03	1.00E-03	5.00E-04	1.00E-04
WSW	E	4.00E-03	4.40E-03	3.50E-03	1.50E-03	2.00E-04	0.00E+00
W	E	7.60E-03	2.27E-02	9.80E-03	1.70E-03	0.00E+00	0.00E+00
WNW	E	5.20E-03	2.05E-02	1.85E-02	2.70E-03	0.00E+00	0.00E+00
NW	E	6.90E-03	2.24E-02	2.72E-02	9.60E-03	1.00E-03	1.00E-04
NNW	E	6.70E-03	1.30E-02	5.30E-03	2.00E-03	1.00E-04	0.00E+00
N	F	4.70E-03	2.80E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
NNE	F	2.10E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NE	F	2.00E-03	3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ENE	F	1.40E-03	8.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E	F	2.30E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ESE	F	2.10E-03	1.50E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	F	2.30E-03	2.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	F	3.10E-03	6.50E-03	8.00E-04	0.00E+00	0.00E+00	0.00E+00
S	F	3.70E-03	7.50E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	F	3.40E-03	5.10E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SW	F	4.70E-03	7.50E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00
WSW	F	4.00E-03	1.25E-02	1.90E-03	1.00E-04	0.00E+00	0.00E+00
W	F	7.60E-03	3.71E-02	5.90E-03	2.00E-04	0.00E+00	0.00E+00
WNW	F	6.00E-03	2.29E-02	5.80E-03	0.00E+00	0.00E+00	0.00E+00
NW	F	4.60E-03	2.66E-02	1.41E-02	1.00E-04	0.00E+00	0.00E+00
NNW	F	5.90E-03	1.39E-02	3.50E-03	0.00E+00	0.00E+00	0.00E+00

Notes:

Dir = wind direction

Stab = stability class

Table G.3.1.35 Stability Array for Year 1993

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
N	A	5.00E-03	8.90E-03	3.50E-03	4.00E-04	0.00E+00	0.00E+00
NNE	A	6.00E-03	4.30E-03	2.80E-03	2.00E-04	0.00E+00	0.00E+00
NE	A	6.20E-03	2.90E-03	1.50E-03	1.20E-03	7.00E-04	0.00E+00
ENE	A	3.60E-03	2.90E-03	9.00E-04	0.00E+00	0.00E+00	0.00E+00
E	A	3.80E-03	4.50E-03	8.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	A	3.60E-03	3.40E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	A	1.60E-03	2.20E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	A	1.30E-03	1.40E-03	5.00E-04	0.00E+00	0.00E+00	0.00E+00
S	A	7.00E-04	9.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	A	8.00E-04	1.50E-03	7.00E-04	5.00E-04	0.00E+00	0.00E+00
SW	A	8.00E-04	2.60E-03	2.10E-03	1.80E-03	1.00E-04	0.00E+00
WSW	A	1.20E-03	1.20E-03	3.60E-03	3.90E-03	8.00E-04	0.00E+00
W	A	9.00E-04	1.80E-03	2.70E-03	2.60E-03	1.00E-04	0.00E+00
WNW	A	6.00E-04	6.00E-04	4.00E-04	2.00E-04	0.00E+00	0.00E+00
NW	A	1.50E-03	3.20E-03	3.60E-03	1.80E-03	1.40E-03	2.00E-04
NNW	A	2.10E-03	5.70E-03	6.00E-03	1.80E-03	4.00E-04	0.00E+00
N	B	3.30E-03	3.80E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
NNE	B	2.10E-03	9.00E-04	2.00E-04	1.00E-04	0.00E+00	0.00E+00
NE	B	1.80E-03	9.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
ENE	B	1.10E-03	1.80E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
E	B	1.60E-03	7.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	B	7.00E-04	5.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	B	1.60E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	B	9.00E-04	7.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
S	B	1.20E-03	6.00E-04	1.00E-04	1.00E-04	0.00E+00	0.00E+00
SSW	B	8.00E-04	1.10E-03	2.00E-04	1.00E-04	0.00E+00	0.00E+00
SW	B	9.00E-04	1.20E-03	5.00E-04	1.00E-04	0.00E+00	0.00E+00
WSW	B	9.00E-04	6.00E-04	9.00E-04	7.00E-04	2.00E-04	0.00E+00
W	B	9.00E-04	8.00E-04	1.10E-03	2.00E-04	4.00E-04	0.00E+00
WNW	B	6.00E-04	5.00E-04	6.00E-04	0.00E+00	0.00E+00	0.00E+00
NW	B	9.00E-04	2.60E-03	2.20E-03	8.00E-04	7.00E-04	0.00E+00
NNW	B	1.40E-03	3.60E-03	1.10E-03	2.00E-04	2.00E-04	0.00E+00
N	C	2.80E-03	4.50E-03	5.00E-04	1.00E-04	0.00E+00	0.00E+00
NNE	C	1.40E-03	1.10E-03	5.00E-04	1.00E-04	0.00E+00	0.00E+00
NE	C	1.10E-03	8.00E-04	2.00E-04	1.00E-04	0.00E+00	0.00E+00
ENE	C	1.10E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E	C	1.50E-03	9.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00

Table G.3.1.35 Stability Array for Year 1993 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
ESE	C	1.20E-03	1.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	C	7.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	C	9.00E-04	4.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
S	C	7.00E-04	6.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
SSW	C	8.00E-04	4.00E-04	2.00E-04	4.00E-04	0.00E+00	0.00E+00
SW	C	9.00E-04	6.00E-04	2.00E-04	2.00E-04	0.00E+00	0.00E+00
WSW	C	5.00E-04	6.00E-04	2.00E-04	4.00E-04	0.00E+00	0.00E+00
W	C	9.00E-04	1.90E-03	8.00E-04	5.00E-04	4.00E-04	0.00E+00
WNW	C	1.40E-03	1.40E-03	6.00E-04	1.00E-04	0.00E+00	0.00E+00
NW	C	1.90E-03	3.90E-03	4.90E-03	5.00E-04	2.00E-04	0.00E+00
NNW	C	1.90E-03	4.80E-03	1.80E-03	6.00E-04	0.00E+00	0.00E+00
N	D	1.15E-02	9.50E-03	1.30E-03	5.00E-04	0.00E+00	0.00E+00
NNE	D	7.70E-03	3.50E-03	5.00E-04	6.00E-04	0.00E+00	0.00E+00
NE	D	6.20E-03	2.20E-03	1.00E-04	6.00E-04	0.00E+00	0.00E+00
ENE	D	6.90E-03	1.10E-03	5.00E-04	4.00E-04	0.00E+00	0.00E+00
E	D	9.00E-03	2.90E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	D	4.60E-03	1.60E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SE	D	4.60E-03	2.20E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	D	4.20E-03	2.60E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
S	D	3.50E-03	2.50E-03	7.00E-04	1.00E-04	0.00E+00	0.00E+00
SSW	D	2.80E-03	1.80E-03	7.00E-04	7.00E-04	0.00E+00	0.00E+00
SW	D	2.30E-03	1.60E-03	1.40E-03	1.30E-03	5.00E-04	0.00E+00
WSW	D	3.40E-03	1.80E-03	1.10E-03	9.00E-04	2.00E-04	1.00E-04
W	D	6.70E-03	5.60E-03	3.60E-03	2.60E-03	6.00E-04	0.00E+00
WNW	D	5.00E-03	6.20E-03	2.20E-03	2.70E-03	1.00E-04	0.00E+00
NW	D	6.80E-03	1.45E-02	1.88E-02	7.30E-03	2.20E-03	1.00E-04
NNW	D	8.60E-03	1.31E-02	8.60E-03	2.70E-03	1.00E-04	0.00E+00
N	E	6.00E-03	4.50E-03	6.00E-04	1.00E-04	0.00E+00	0.00E+00
NNE	E	3.00E-03	1.60E-03	9.00E-04	5.00E-04	0.00E+00	0.00E+00
NE	E	3.20E-03	1.40E-03	6.00E-04	1.00E-04	1.00E-04	0.00E+00
ENE	E	3.00E-03	1.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E	E	5.20E-03	2.30E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	E	4.20E-03	1.90E-03	0.00E+00	4.00E-04	1.00E-04	0.00E+00
SE	E	5.30E-03	2.00E-03	1.00E-04	0.00E+00	0.00E+00	0.00E+00
SSE	E	5.50E-03	4.10E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
S	E	4.10E-03	3.60E-03	7.00E-04	6.00E-04	0.00E+00	0.00E+00
SSW	E	3.80E-03	1.90E-03	1.10E-03	6.00E-04	1.00E-04	0.00E+00

Table G.3.1.35 Stability Array for Year 1993 (cont'd)

Dir	Stab	ws1	ws2	ws3	ws4	ws5	ws6
SW	E	4.50E-03	3.30E-03	9.00E-04	1.40E-03	9.00E-04	1.00E-04
WSW	E	5.90E-03	4.80E-03	2.20E-03	1.30E-03	2.00E-04	1.00E-04
W	E	8.90E-03	1.71E-02	1.07E-02	3.60E-03	2.00E-04	0.00E+00
WNW	E	6.30E-03	2.09E-02	1.37E-02	2.30E-03	0.00E+00	1.00E-04
NW	E	7.00E-03	2.45E-02	2.40E-02	1.06E-02	1.20E-03	5.00E-04
NNW	E	4.30E-03	1.34E-02	5.70E-03	2.00E-03	4.00E-04	0.00E+00
N	F	6.20E-03	4.10E-03	2.00E-04	0.00E+00	0.00E+00	0.00E+00
NNE	F	2.30E-03	9.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00
NE	F	2.80E-03	7.00E-04	2.00E-04	0.00E+00	0.00E+00	0.00E+00
ENE	F	2.10E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E	F	3.60E-03	2.20E-03	4.00E-04	0.00E+00	0.00E+00	0.00E+00
ESE	F	2.30E-03	7.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE	F	3.60E-03	2.50E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SSE	F	3.60E-03	4.60E-03	6.00E-04	0.00E+00	0.00E+00	0.00E+00
S	F	5.40E-03	7.50E-03	2.00E-04	2.00E-04	0.00E+00	0.00E+00
SSW	F	4.60E-03	5.50E-03	4.00E-04	0.00E+00	1.00E-04	0.00E+00
SW	F	4.00E-03	7.70E-03	9.00E-04	1.00E-04	0.00E+00	1.00E-04
WSW	F	3.50E-03	1.36E-02	3.60E-03	2.00E-04	0.00E+00	0.00E+00
W	F	7.00E-03	2.65E-02	5.20E-03	4.00E-04	0.00E+00	0.00E+00
WNW	F	5.40E-03	2.08E-02	3.00E-03	0.00E+00	0.00E+00	0.00E+00
NW	F	5.60E-03	2.50E-02	1.37E-02	1.00E-04	0.00E+00	0.00E+00
NNW	F	5.60E-03	1.11E-02	2.30E-03	0.00E+00	0.00E+00	0.00E+00

Notes:

Dir = wind direction

Stab = stability class

Table G.4.0.1 Modeling Results for the No Action Alternative (Tank Waste)

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	2.4 E-02	571700, 127700	40,000	40,000
	8 hour	1.6 E-02	571700, 127700	10,000	10,000
Nitrogen Oxides	Annual (1993)	1.1E-05	583500, 128500	100	100
1,3 -Butadiene	Annual (1993)	7.5E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	1.1E-03	573400, 126700	N/A	67
2 -Pentanone	24 hour	1.7 E-03	573400, 126700	N/A	2300
Acetone	24 hour	2.1 E-02	573400, 126700	N/A	5900
Acetonitrile	24 hour	9.8 E-03	573400, 126700	N/A	24
Ammonia	24 hour	6.9 E-02	571700, 127700	N/A	100
Benzene	Annual (1993)	6.0E-06	583500, 128500	N/A	0.12
Heptane	24 hour	1.2 E-03	573400, 126700	N/A	5500
Hexane	24 hour	1.3 E-03	573400, 126700	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0 E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	1.0 E-05	585500, 144500	N/A	500
Nonane	24 hour	6.5 E-03	573400, 126700	N/A	3500
Octane	24 hour	6.8 E-04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.3 E-03	569500, 130500	N/A	3.3
Toluene	24 hour	9.5 E-05	573400, 126700	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents the data year producing the highest impact.

Impact from the No Action alternative (capsules) are also analyzed in this table.

Table G.4.0.2 Modeling Results for the Long-Term Management Alternative Phase 1

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x,y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	2.5	567900, 130300	40,000	40,000
	8 hour	1.8	567900, 130300	10,000	10,000
Nitrogen Oxides	Annual (1992)	2.2E-03	583500, 128500	100	100
Sulfur Oxides	1 hour	0.13	583500, 128500	N/A	655
	3 hour	0.11	583500, 128500	1300	1300
	24 hour	5.0E-02	583500, 128500	365	260
	Annual (1992)	7.2E-04	583500, 128500	80	60
PM-10	24 hour	1.4	583500, 128500	150	150
	Annual (1992)	2.0E-02	583500, 128500	50	50
Formaldehyde	Annual (1992)	7.1E-05	583500, 128500	N/A	0.077
1,3 -Butadiene	Annual (1993)	1.9E-06	569500, 130500	N/A	0.0036
2 -Hexanone	24 hour	3.1E-03	563700, 132200	N/A	67
2 -Pentanone	24 hour	5.0E-03	563700, 132200	N/A	2300
Acetone	24 hour	6.0E-02	563700, 132200	N/A	5900
Acetonitrile	24 hour	3.0E-02	563700, 132200	N/A	24
Ammonia	24 hour	0.30	563700, 132200	N/A	100
Benzene	Annual (1993)	1.5E-05	569500, 130500	N/A	0.12
Heptane	24 hour	3.5E-02	563700, 132200	N/A	5500
Hexane	24 hour	3.7E-03	563700, 132200	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10.E-03	585500, 144500	N/A	500
Nonane	24 hour	1.9E-03	563700, 132200	N/A	3500
Octane	24 hour	2E-03	563700, 132200	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	5.4E-03	563700, 132200	N/A	3.3
Toluene	24 hour	2.8E-04	563700, 132200	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents the data year producing the highest impact.

Table G.4.0.3 Modeling Results for the Long-Term Management Alternative Phase 2

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	2.5	571500, 128500	40,000	40,000
	8 hour	1.8	571500, 128500	10,000	10,000
Nitrogen Oxides	Annual (1992)	2.2E-03	583500, 128500	100	100
Sulfur Oxides	1 hour	1.3E-01	571500, 128500	N/A	655
	3 hour	1.1E-01	571500, 128500	1300	N/A
	24 hour	5.0E-02	571500, 128500	365	260
	Annual (1992)	7.2E-04	583500, 126500	80	60
PM-10	24 hour	1.4	571500, 128500	150	150
	Annual (1992)	2.0E-02	583500, 128500	50	50
Formaldehyde	Annual (1992)	7.1E-05	583500, 128500	N/A	0.077
1,3 -Butadiene	Annual (1992)	8.5E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	1.7E-03	571500, 128500	N/A	67
2 -Pentanone	24 hour	1.7E-03	571500, 128500	N/A	2300
Acetone	24 hour	2.1E-02	571500, 128500	N/A	5900
Acetonitrile	24 hour	9.9E-03	571500, 128500	N/A	24
Ammonia	24 hour	6.1E-02	571500, 128500	N/A	100
Benzene	Annual (1992)	6.8E-06	583500, 128500	N/A	0.12
Heptane	24 hour	1.2E-03	571500, 128500	N/A	5500
Hexane	24 hour	3.7E-03	563700, 132200	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E-03	585500, 144500	N/A	500
Nonane	24 hour	6.5E-04	571500, 128500	N/A	3500
Octane	24 hour	6.9E-04	571500, 128500	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.0E-03	571500, 128500	N/A	3.3
Toluene	24 hour	9.6E-05	571500, 128500	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.4 Modeling Results for the In Situ Fill and Cap Alternative

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	49	563700, 132200	40,000	40,000
	8 hour	35	563700, 132200	10,000	10,000
Nitrogen Oxides	Annual (1992)	4.5E-03	569500, 130500	100	100
Sulfur Oxides	1 hour	24	563700, 132200	N/A	655
	3 hour	21	563700, 132200	1300	N/A
	24 hour	9.5	563700, 132200	365	260
	Annual (1992)	9.6E-02	569500, 130500	80	60
PM-10	24 hour	4.0	563700, 132200	150	150
	Annual (1992)	0.29	571500, 128500	50	50
Formaldehyde	Annual (1992)	7.7E-05	569500, 130500	N/A	0.077
1,3 -Butadiene	Annual (1993)	1.9E-06	569500, 130500	N/A	0.0036
2 -Hexanone	24 hour	3.0E-03	564800, 131200	N/A	67
2 -Pentanone	24 hour	4.7E-03	564800, 131200	N/A	2300
Acetone	24 hour	6.0E-02	564800, 131200	N/A	5900
Acetonitrile	24 hour	3.0E-02	564800, 131200	N/A	24
Ammonia	24 hour	0.30	564800, 131200	N/A	100
Benzene	Annual (1993)	1.5E-05	569500, 130500	N/A	0.12
Heptane	24 hour	3.3E-03	564800, 131200	N/A	5500
Hexane	24 hour	3.5E-03	564800, 131200	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E-03	585500, 144500	N/A	500
Nonane	24 hour	1.8E-03	564800, 131200	N/A	3500
Octane	24 hour	1.9E-03	564800, 131200	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	5.2E-03	564800, 131200	N/A	3.3
Toluene	24 hour	2.6E-04	564800, 131200	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using the data meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.5 Modeling Results for the In Situ Vitrification Alternative

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	980	563700, 132200	40,000	40,000
	8 hour	690	563700, 132200	10,000	10,000
Nitrogen Oxides	Annual (1993)	1.5	569500, 130500	100	100
Sulfur Oxides	1 hour	68	563700, 132200	N/A	655
	3 hour	6.1	563700, 132200	1300	N/A
	24 hour	27	563700, 132200	365	260
	Annual (1992)	2.8E-01	569500, 130500	80	60
PM-10	24 hour	96	563700, 132200	150	150
	Annual (1992)	1.0	569500, 130500	50	50
Formaldehyde	Annual (1992)	3.1E-04	569500, 130500	N/A	0.077
1,3 -Butadiene	Annual (1993)	7.5E-07	569500, 130500	N/A	0.0036
2 -Hexanone	24 hour	1.1E-03	573400, 126700	N/A	67
2 -Pentanone	24 hour	1.7E-03	573400, 126700	N/A	2300
Acetone	24 hour	2.0E-02	573400, 126700	N/A	5900
Acetonitrile	24 hour	9.8E-03	573400, 126700	N/A	24
Ammonia	24 hour	0.85	559500, 132500	N/A	100
Benzene	Annual (1993)	6.0E-06	569500, 130500	N/A	0.12
Heptane	24 hour	1.2E-03	573400, 126700	N/A	5500
Hexane	24 hour	1.3E-03	573400, 126700	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E-03	585500, 144500	N/A	500
Nonane	24 hour	6.5E-04	573400, 126700	N/A	3500
Octane	24 hour	6.8E-04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.3E-03	569500, 130500	N/A	3.3
Toluene	24 hour	9.5E-05	573400, 126700	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.6 Modeling Results for the Ex Situ Intermediate Separations Alternative - Construction Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	2900	567900, 130300	40,000	40,000
	8 hour	2050	567900, 130300	10,000	10,000
Nitrogen Oxides	Annual (1992)	1.9	583500, 128500	100	100
Sulfur Oxides	1 hour	7.3	567900, 130300	N/A	655
	3 hour	6.5	567900, 130300	1300	N/A
	24 hour	2.9	567900, 130300	365	260
	Annual (1992)	2.7E-02	583500, 128500	80	60
PM-10	24 hour	93	567900, 130300	150	150
	Annual (1992)	1.0	583500, 128500	50	50
Formaldehyde	Annual (1992)	4.8E-04	583500, 128500	N/A	0.077
1,3 -Butadiene	Annual (1993)	7.5E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	1.1E-03	573400, 126700	N/A	67
2 -Pentanone	24 hour	1.7E-03	573400, 126700	N/A	2300
Acetone	24 hour	2.0E-02	573400, 126700	N/A	5900
Acetonitrile	24 hour	9.8E-03	573400, 126700	N/A	24
Ammonia	24 hour	7.0E-02	571700, 127700	N/A	100
Benzene	Annual (1993)	6.0E-06	583500, 128500	N/A	0.12
Heptane	24 hour	1.2E-03	573400, 126700	N/A	5500
Hexane	24 hour	1.3E-03	573400, 126700	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E-03	585500, 144500	N/A	500
Nonane	24 hour	6.5E-04	573400, 126700	N/A	3500
Octane	24 hour	6.8E-04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.3E-03	569500, 130500	N/A	3.3
Toluene	24 hour	9.5E-05	573400, 126700	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.7 Modeling Results for the Ex Situ Intermediate Separations Alternative - Operation Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	60	585500, 142500	40,000	40,000
	8 hour	42	585500, 142500	10,000	10,000
Nitrogen Oxides	Annual (1992)	0.12	569500, 130500	100	100
Sulfur Oxides	1 hour	4.9	585500, 142500	N/A	655
	3 hour	4.4	585500, 142500	1300	N/A
	24 hour	2.0	585500, 142500	365	260
	Annual (1990)	2.1E-02	587500, 140500	80	60
PM-10	24 hour	0.75	564800, 142500	150	150
	Annual (1993)	7.8E-03	569500, 130500	50	50
Formaldehyde	Annual (1992)	2.8E-05	569500, 130500	N/A	0.077
1,3 -Butadiene	Annual (1993)	1.9E-06	569500, 130500	N/A	0.0036
2 -Hexanone	24 hour	3.1E-03	563700, 132200	N/A	67
2 -Pentanone	24 hour	5.0E-03	563700, 132200	N/A	2300
Acetone	24 hour	6.0E-02	563700, 132200	N/A	5900
Acetonitrile	24 hour	3.0E-02	563700, 132200	N/A	24
Ammonia	24 hour	0.40	563700, 132200	N/A	100
Antimony Compounds	24 hour	1.1E-08	585500, 142500	N/A	1.7
Arsenic Compounds	Annual (1990)	7.4E-11	587500, 140500	N/A	0.00023
Barium Oxide	24 hour	1.2E-08	585500, 142500	N/A	1.7
Benzene	Annual (1993)	1.5E-05	169500, 130500	N/A	0.12
Beryllium Compounds	Annual (1990)	1.4E-12	587500, 140500	N/A	0.00042
Boric Oxide	24 hour	1.2E-05	585500, 142500	N/A	33
Cadmium Compounds	Annual (1990)	6.8E-10	587500, 140500	N/A	0.00056
Calcium Oxide	24 hour	2.4E-05	585500, 142500	N/A	6.7
	Annual	1.1E-05	585500, 142500	N/A	0
Chromium Compounds	24 hour	1.7E-06	585500, 142500	N/A	1.7
	Annual (1990)	1.8E-08	587500, 140500	N/A	0.00083
Cobalt Compounds	24 hour	5.0E-09	585500, 142500	N/A	0.17
Ferric Oxide	24 hour	5.0E-06	585500, 142500	N/A	17
Fluoride (as HF)	24 hour	0.12	585500, 142500	N/A	2.9
HCl	24 hour	5.0E-02	585500, 142500	N/A	7
Heptane	24 hour	4.0E-03	563700, 132200	N/A	5500

Table G.4.0.7 Modeling Results for the Ex Situ Intermediate Separations Alternative - Operation Phase (cont'd)

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Hexane	24 hour	4.0E-03	563700, 132200	N/A	200
Iodine	24 hour	4.0E-03	585500, 142500	N/A	3.3
Lead Compounds	24 hour	1.7E-07	585500, 142500	N/A	0.5
Magnesium Oxide	24 hour	2.4E-05	585500, 142500	N/A	33
Manganese Compounds	24 hour	9.7E-07	585500, 142500	N/A	0.4
Methyl Isobutyl Ketone	24 hour	9.0E-05	563700, 132200	N/A	680
N-Butyl Alcohol	24 hour	1.0E-02	585500, 144500	N/A	500
Nickel Compounds	Annual (1990)	9.6E-06	587500, 140500	N/A	0.0021
Nitric Acid	24 hour	2.0E-02	585500, 142500	N/A	17
Nonane	24 hour	1.9E-03	563700, 132200	N/A	3500
Octane	24 hour	2E-03	563700, 132200	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.0E-02	563700, 132200	N/A	3.3
Selenium Compounds	24 hour	1.9E-08	585500, 142500	N/A	0.67
Silver Oxide	24 hour	2.1E-09	585500, 142500	N/A	0.033
Tellurium Trioxide	24 hour	1.5E-09	585500, 142500	N/A	0.33
Toluene	24 hour	2.8E-04	563700, 132200	N/A	400
Uranium Trioxide	24 hour	7.2E-06	585500, 142500	N/A	0.67
Vanadium Pentoxide	24 hour	4.2E-10	585500, 142500	N/A	0.17
Zinc Oxide	24 hour	1.6E-08	585500, 142500	N/A	17
Zirconium Oxide	24 hour	3.3E-06	585500, 142500	N/A	17

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.8 Modeling Results for the Ex Situ No Separations Alternative - Construction Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	2500	567900, 130300	40,000	40,000
	8 hour	1700	567900, 130300	10,000	10,000
Nitrogen Oxides	Annual (1992)	1.6	583500, 128500	100	100
Sulfur Oxides	1 hour	6.6	567900, 130300	N/A	655
	3 hour	6.0	567900, 130300	1300	N/A
	24 hour	2.7	567900, 130300	365	260
	Annual (1993)	3.0E-02	569500, 130500	80	60
PM-10	24 hour	85	567900, 130300	150	150
	Annual (1992)	0.88	583500, 128500	50	50
Formaldehyde	Annual (1992)	1.7E-03	569500, 130500	N/A	0.077
1,3 -Butadiene	Annual (1993)	7.5E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	1.1E-03	573400, 126700	N/A	67
2 -Pentanone	24 hour	1.7E-03	573400, 126700	N/A	2300
Acetone	24 hour	2.0E-02	573400, 126700	N/A	5900
Acetonitrile	24 hour	9.8E-03	573400, 126700	N/A	24
Ammonia	24 hour	7.0E-02	571700, 127700	N/A	100
Benzene	Annual (1993)	6.0E-06	583500, 128500	N/A	0.12
Heptane	24 hour	1.2E-03	573400, 126700	N/A	5500
Hexane	24 hour	1.3E-03	573400, 126700	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E 03	585500, 144500	N/A	500
Nonane	24 hour	6.5E-04	573400, 126700	N/A	3500
Octane	24 hour	6.8E 04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.3E-03	569500, 130500	N/A	3.3
Toluene	24 hour	9.5E-05	573400, 126700	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Modeling results from vitrification and calcination are the same.

Table G.4.0.9 Modeling Results for the Ex Situ No Separations Alternative - Operation Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	85	585500, 142500	40,000	40,000
	8 hour	60	585500, 142500	10,000	10,000
Nitrogen Oxides	Annual (1992)	0.12 (vitrification)	569500, 130500	100	100
	Annual (1992)	0.13 (calcination)	569500, 130500	100	100
Sulfur Oxides	1 hour	8.6	585500, 142500	N/A	655
	3 hour	7.7	585500, 142500	1300	N/A
	24 hour	3.41	585500, 142500	365	260
	Annual (1990)	3.0E-02	587500, 140500	80	60
PM-10	24 hour	0.75	564800, 131200	150	150
	Annual (1992)	7.9E-03	569500, 130500	50	50
Formaldehyde	Annual (1992)	2.8E-05	569500, 130500	N/A	0.077
1,3 -Butadiene	Annual (1993)	1.9E-06	569500, 130500	N/A	0.0036
2 -Hexanone	24 hour	3.1E-03	563700, 132200	N/A	67
2 -Pentanone	24 hour	5.0E-03	563700, 132200	N/A	2300
Acetone	24 hour	6.0E-02	563700, 132200	N/A	5900
Acetonitrile	24 hour	3.0E-02	563700, 132200	N/A	24
Ammonia	24 hour	0.38	563700, 132200	N/A	100
Antimony Compounds	24 hour	2.0E-10	585500, 142500	N/A	1.7
Arsenic Compounds	Annual (1990)	9.2E-13	587500, 140500	N/A	0.00023
Benzene	Annual (1993)	1.5E-05	569500, 130500	N/A	0.12
Beryllium Compounds	Annual (1990)	1.9E-12	587500, 140500	N/A	0.00042
Boric Oxide	24 hour	3.4E-06	585500, 142500	N/A	33
Cadmium Compounds	Annual (1990)	8.6E-12	587500, 140500	N/A	0.00056
Calcium Oxide	24 hour	2.6E-07	585500, 142500	N/A	6.7
Chromium Compounds	24 hour	2.1E-08	585500, 142500	N/A	1.7
	Annual (1990)	1.9E-10	587500, 140500		0.00083
Cobalt Compounds	24 hour	9.2E-11	585500, 142500	N/A	0.17
Ferric Oxide	24 hour	1.0E-07	585500, 142500	N/A	17
Fluoride (as HF)	24 hour	0.27	585500, 142500	N/A	2.9
HCl	24 hour	0.11	585500, 142500	N/A	7
Heptane	24 hour	4.0E-03	563700, 132200	N/A	5500
Hexane	24 hour	4.0E-03	563700, 132200	N/A	200

Table G.4.0.9 Modeling Results for the Ex Situ No Separations Alternative - Operation Phase (cont'd)

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Iodine	24 hour	5.0E-03	585500, 142500	N/A	3.3
Lead Compounds	24 hour	3.0E-09	585500, 142500	N/A	0.5
Magnesium Oxide	24 hour	2.4E-07	585500, 142500	N/A	33
Manganese Compounds	24 hour	1.9E-05	585500, 142500	N/A	0.4
Methyl Isobutyl Ketone	24 hour	9.0E-05	563700, 132200	N/A	680
Nitric Acid	24 hour	2.0E-02	585500, 142500	N/A	17
Nonane	24 hour	1.9E-03	563700, 132200	N/A	3500
Octane	24 hour	2.0E-03	563700, 132200	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.0E-02	563700, 132200	N/A	3.3
Selenium Compounds	24 hour	3.1E-10	585500, 142500	N/A	0.67
Silver Oxide	24 hour	3.8E-11	585500, 142500	N/A	0.033
Tellurium Trioxide	24 hour	2.8E-11	585500, 142500	N/A	0.33
Toluene	24 hour	2.8E-04	563700, 132200	N/A	400
Uranium Trioxide	24 hour	1.4E-07	585500, 142500	N/A	0.67
Vanadium Pentoxide	24 hour	7.0E-12	585500, 142500	N/A	0.17
Zinc Oxide	24 hour	2.4E-10	585500, 142500	N/A	17
Zirconium Oxide	24 hour	6.7E-08	585500, 142500	N/A	17

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Additional emissions from routine operations of tank farm and evaporator are as shown in Table G.3.1.3.

Table G.4.0.10 Modeling Results for the Ex Situ Extensive Separations Alternative - Construction Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	3500	571500, 128500	40,000	40,000
	8 hour	2500	571500, 128500	10,000	10,000
Nitrogen Oxides	Annual (1992)	2.2	583500, 128500	100	100
Sulfur Oxides	1 hour	8.0	567900, 130300	N/A	655
	3 hour	7.2	567900, 130300	1300	N/A
	24 hour	3.2	567900, 130300	365	260
	Annual (1992)	3.1E-02	583500, 128500	80	60
PM-10	24 hour	95	567900, 130300	150	150
	Annual (1992)	1.0	583500, 128500	50	50
Formaldehyde	Annual (1992)	5.6E-04	583500, 128500	N/A	0.077
1,3 -Butadiene	Annual (1993)	7.5E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	1.1E-03	573400, 126700	N/A	67
2 -Pentanone	24 hour	1.7E-03	573400, 126700	N/A	2300
Acetone	24 hour	2.0E-02	573400, 126700	N/A	5900
Acetonitrile	24 hour	9.8E-03	573400, 126700	N/A	24
Ammonia	24 hour	7.0E-02	571700, 127700	N/A	100
Benzene	Annual (1993)	6.0E-06	583500, 128500	N/A	0.12
Heptane	24 hour	1.2E-03	573400, 126700	N/A	5500
Hexane	24 hour	1.3E-03	573400, 126700	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E-03	585500, 144500	N/A	500
Nonane	24 hour	6.5E-04	573400, 126700	N/A	3500
Octane	24 hour	6.8E-04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.3E-03	569500, 130500	N/A	3.3
Toluene	24 hour	9.5E-05	573400, 126700	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.11 Modeling Results for the Ex Situ Extensive Separations - Operation Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	27	585500, 142500	40,000	40,000
	8 hour	19	585500, 142500	10,000	10,000
Nitrogen Oxides	Annual (1990)	1.7	587500, 140500	100	100
Sulfur Oxides	1 hour	14	585500, 142500	N/A	655
	3 hour	13	585500, 142500	1300	N/A
	24 hour	5.6	585500, 142500	365	260
	Annual (1990)	6.0E-02	587500, 140500	80	60
PM-10	24 hour	1.4	571500, 128500	150	150
	Annual (1992)	2.0E-02	583500, 128500	50	50
Formaldehyde	Annual (1992)	7.1E-05	583500, 128500	N/A	0.077
1,3 -Butadiene	Annual (1993)	1.9E-06	569500, 130500	N/A	0.0036
2 -Hexanone	24 hour	3.0E-03	563700, 132200	N/A	67
2 -Pentanone	24 hour	5.0E -03	563700, 132200	N/A	2300
Acetone	24 hour	6.0E-02	563700, 132200	N/A	5900
Acetonitrile	24 hour	3.0E-02	563700, 132200	N/A	24
Ammonia	24 hour	0.38	563700, 132200	N/A	100
Benzene	Annual (1993)	1.5E-05	569500, 130500	N/A	0.12
Chromium Compounds	24 hour	1.9E-04	585500, 142500	N/A	1.7
	Annual (1990)	2.1E-06	587500, 140500	N/A	0.00083
Fluoride (as HF)	24 hour	1.0E-02	585500, 142500	N/A	2.9
Heptane	24 hour	4.0E-03	563700, 132200	N/A	5500
Hexane	24 hour	4.0E-03	563700, 132200	N/A	200
Manganese Compounds	24 hour	4.1E-05	585500, 142500	N/A	0.4
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E-03	585500, 144500	N/A	500
Nickel Compounds	Annual (1990)	6.7E-08	587500, 140500	N/A	.0021
Nitric Acid	24 hour	9.0E-02	585500, 142500	N/A	17
Nonane	24 hour	2.0E-03	563700, 132200	N/A	3500
Octane	24 hour	3.0E-03	563700, 132200	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	5.0E-03	563700, 132200	N/A	3.3
Toluene	24 hour	2.8E-04	563700, 132200	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.12 Modeling Results for the Ex Situ/In Situ Combination Alternative - Construction Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	1100	567900, 130300	40,000	40,000
	8 hour	800	567900, 130300	10,000	10,000
Nitrogen Oxide	Annual (1993)	1.1	569500, 130500	100	100
Sulfur Oxides	1 hour	27	563700, 132200	N/A	655
	3 hour	24	563700, 132200	1300	N/A
	24 hour	11	563700, 132200	365	260
	Annual (1992)	0.11	569500, 130500	80	60
PM-10	24 hour	51	563700, 132200	150	150
	Annual (1992)	0.60	569500, 130500	50	50
Formaldehyde	Annual (1992)	1.9E-04	583500, 128500	N/A	0.077
1,3 -Butadiene	Annual (1993)	7.5E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	1.1E-03	573400, 126700	N/A	67
2 -Pentanone	24 hour	1.7E-03	573400, 126700	N/A	2300
Acetone	24 hour	2.0E-02	573400, 126700	N/A	5900
Acetonitrile	24 hour	9.8E-03	573400, 126700	N/A	24
Ammonia	24 hour	7.0E-02	571700, 127700	N/A	100
Benzene	Annual (1993)	6.0E-06	58.500, 128500	N/A	0.12
Heptane	24 hour	1.2E-03	573400, 126700	N/A	5500
Hexane	24 hour	1.3E-03	573400, 126700	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10.E-03	585500, 144500	N/A	500
Nonane	24 hour	6.5E-04	573400, 126700	N/A	3500
Octane	24 hour	6.8E-04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.3E-03	569500, 130500	N/A	3.3
Toluene	24 hour	9.5E-05	573400, 126700	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.13 Modeling Results for the Ex Situ/In Situ Combination Alternative - Operation Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	32	567500, 124500	40,000	40,000
	8 hour	22	567500, 124500	10,000	10,000
Nitrogen Oxides	Annual (1992)	5.9E-02	569500, 130500	100	100
Sulfur Oxides	1 hour	2.5	585500, 142500	N/A	655
	3 hour	2.2	585500, 142500	1300	N/A
	24 hour	0.98	585500, 142500	365	260
	Annual (1990)	1.0E-02	587500, 140500	80	60
PM-10	24 hour	1.4	564800, 131200	150	150
	Annual (1992)	1.4E-02	569500, 130500	50	50
Formaldehyde	Annual (1992)	1.4E-05	569500, 130500	N/A	0.077
1,3 -Butadiene	Annual (1993)	7.5E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	3.1E-03	563700, 132200	N/A	67
2 -Pentanone	24 hour	5.0E-03	563700, 132200	N/A	2300
Acetone	24 hour	6.0E-02	563700, 132200	N/A	5900
Acetonitrile	24 hour	2.9E-02	563700, 132200	N/A	24
Ammonia	24 hour	2.7E-01	563700, 132200	N/A	100
Antimony Compounds	24 hour	5.6E-09	563700, 132200	N/A	1.7
Arsenic Compounds	Annual (1990)	3.7E-11	587500, 140500	N/A	0.00023
Barium Oxide	24 hour	6.0E-09	585500, 142500	N/A	1.7
Benzene	Annual (1993)	6.0E-06	583500, 128500	N/A	0.12
Beryllium Compounds	Annual (1990)	7.2E-13	587500, 140500	N/A	0.00042
Boric Oxide	24 hour	1.7E-04	585500, 142500	N/A	33
Cadmium Compounds	Annual (1990)	3.4E-10	587500, 140500	N/A	0.00056
Calcium Oxide	24 hour	1.2E-05	585500, 142500	N/A	6.7
Chromium Compounds	24 hour	8.3E-07	585500, 142500	N/A	1.7
	Annual (1990)	8.9E-09	587500, 140500		0.00083
Cobalt Compounds	24 hour	2.5E-09	587500, 140500	N/A	0.17
Ferric Oxide	24 hour	2.5E-06	587500, 140500	N/A	.17
Fluoride (as HF)	24 hour	5.9E-02	587500, 140500	N/A	2.9
HCl	24 hour	2.5E-02	587500, 140500	N/A	7
Heptane	24 hour	1.2E-03	573400, 126700	N/A	5500

Table G.4.0.13 Modeling Results for the Ex Situ/In Situ Combination Alternative - Operation Phase (cont'd)

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Hexane	24 hour	1.3E-03	573400, 126700	N/A	200
Iodine	24 hour	1.8E-03	585500, 142500	N/A	3.3
Lead Compounds	24 hour	8.3E-08	585500, 142500	N/A	0.5
Manganese Compounds	24 hour	4.8E-07	585500, 142500	N/A	0.4
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E-03	585500, 144500	N/A	500
Nickel Compounds	Annual (1990)	4.8E-06	587500, 140500	N/A	0.0021
Nitric Acid	24 hour	2.0E-02	585500, 142500	N/A	17
Nonane	24 hour	6.5E-04	573400, 126700	N/A	3500
Octane	24 hour	6.8E-04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.3E-03	569500, 130500	N/A	3.3
Selenium Compounds	24 hour	9.6E-09	585500, 142500	N/A	0.67
Silver Oxide	24 hour	1.1E-09	585500, 142500	N/A	0.033
Tellurium Trioxide	24 hour	7.4E-10	585500, 142500	N/A	0.33
Toluene	24 hour	9.5E-05	573400, 126700	N/A	400
Uranium Trioxide	24 hour	3.9E-06	585500, 142500	N/A	0.67
Vanadium Pentoxide	24 hour	2.1E-10	585500, 142500	N/A	0.17
Zinc Oxide	24 hour	8.0E-09	585500, 142500	N/A	17
Zirconium Oxide	24 hour	1.6E-06	585500, 142500	N/A	17

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.14 Modeling Results for the Phased Implementation Alternative Phase 1 - Construction Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	1100	571700, 127700	40,000	40,000
	8 hour	800	571700, 127700	10,000	10,000
Nitrogen Oxides	Annual (1993)	1.3	583500, 128500	100	100
Sulfur Oxides	1 hour	4.8	571700, 127700	N/A	655
	3 hour	4.3	571700, 127700	1300	N/A
	24 hour	3.2	571700, 127700	365	260
	Annual (1993)	2.9E-02	583500, 128500	80	60
PM-10	24 hour	87	571700, 127700	150	150
	Annual (1993)	1.2	583500, 128500	50	50
Formaldehyde	Annual (1993)	5.2E-06	583500, 128500	N/A	0.077
1,3 -Butadiene	Annual (1993)	7.6E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	1.1E-03	573400, 126700	N/A	67
2 -Pentanone	24 hour	1.7E-03	573400, 126700	N/A	2300
Acetone	24 hour	2.0E-02	573400, 126700	N/A	5900
Acetonitrile	24 hour	9.8E-03	573400, 126700	N/A	24
Ammonia	24 hour	7.0E-02	571700, 127700	N/A	100
Benzene	Annual (1993)	6.0E-06	583500, 128500	N/A	0.12
Heptane	24 hour	1.2E-03	573400, 126700	N/A	5500
Hexane	24 hour	1.3E-03	573400, 126700	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E-03	585500, 144500	N/A	500
Nonane	24 hour	6.5E-04	573400, 126700	N/A	3500
Octane	24 hour	6.8E-04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.3E-03	569500, 130500	N/A	3.3
Toluene	24 hour	9.5E-05	573400, 126700	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.15 Modeling Results for the Phased Implementation Alternative Phase 1 - Operation Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	39	569500, 124500	40,000	40,000
	8 hour	27	569500, 124500	10,000	10,000
Nitrogen Oxides	Annual (1993)	9.6E-03	583500, 128500	100	100
Sulfur Oxides	1 hour	2.4	569500, 124500	N/A	655
	3 hour	2.1	569500, 124500	1300	N/A
	24 hour	0.9	569500, 124500	365	260
	Annual (1993)	1.4E-02	583500, 128500	80	60
PM-10	24 hour	5.0E-02	587500, 142500	150	150
	Annual (1993)	7.1E-04	583500, 128500	50	50
1,3 -Butadiene	Annual (1993)	1.9E-06	569500, 130500	N/A	0.0036
2 -Hexanone	24 hour	3.0E-03	563700, 132200	N/A	67
2 -Pentanone	24 hour	5.0E -03	563700, 132200	N/A	2300
Acetone	24 hour	6.0E-02	563700, 132200	N/A	5900
Acetonitrile	24 hour	3.0E-02	563700, 132200	N/A	24
Ammonia	24 hour	0.38	563700, 132200	N/A	100
Benzene	Annual (1993)	1.5E-05	569500, 130500	N/A	0.12
Chromium Compounds	24 hour	3.5E-07	569500, 124500	N/A	1.7
	Annual (1993)	5.1E-09	583500, 128500	N/A	0.00083
Fluoride (as HF)	24 hour	1.0E-02	585500, 142500	N/A	2.9
Heptane	24 hour	4.0E-03	563700, 132200	N/A	5500
Hexane	24 hour	4.0E-03	563700, 132200	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10E-03	585500, 144500	N/A	500
Nickel Compounds	Annual (1993)	1.9E-10	583500, 128500	N/A	.0021
Nitric Acid	24 hour	9.0E-02	585500, 142500	N/A	17
Nonane	24 hour	2.0E-03	563700, 132200	N/A	3500
Octane	24 hour	3.0E-03	563700, 132200	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	5.0E-03	563700, 132200	N/A	3.3
Toluene	24 hour	2.8E-04	563700, 132200	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.16 Modeling Results for the Phased Implementation Alternative Phase 2 - Construction Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	1100	567900, 130300	40,000	40,000
	8 hour	800	567900, 130300	10,000	10,000
Nitrogen Oxide	Annual (1993)	1.1	569500, 130500	100	100
Sulfur Oxides	1 hour	27	563700, 132200	N/A	655
	3 hour	24	563700, 132200	1300	N/A
	24 hour	11	563700, 132200	365	260
	Annual (1992)	0.11	569500, 130500	80	60
PM-10	24 hour	51	563700, 132200	150	150
	Annual (1992)	0.60	569500, 130500	50	50
Formaldehyde	Annual (1992)	1.9E-04	583500, 128500	N/A	0.077
1,3 -Butadiene	Annual (1993)	7.5E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	1.1E-03	573400, 126700	N/A	67
2 -Pentanone	24 hour	1.7E-03	573400, 126700	N/A	2300
Acetone	24 hour	2.0E-02	573400, 126700	N/A	5900
Acetonitrile	24 hour	9.8E-03	573400, 126700	N/A	24
Ammonia	24 hour	7.0E-02	571700, 127700	N/A	100
Benzene	Annual (1993)	6.0E-06	58.500, 128500	N/A	0.12
Heptane	24 hour	1.2E-03	573400, 126700	N/A	5500
Hexane	24 hour	1.3E-03	573400, 126700	N/A	200
Methyl Isobutyl Ketone	24 hour	9.0E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	10.E-03	585500, 144500	N/A	500
Nonane	24 hour	6.5E-04	573400, 126700	N/A	3500
Octane	24 hour	6.8E-04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.3E-03	569500, 130500	N/A	3.3
Toluene	24 hour	9.5E-05	573400, 126700	N/A	400

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.17 Modeling Results for the Phased Implementation Alternative Phase 2 - Operation Phase

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	7.38E+01	571500, 122500	40,000	40,000
	8 hour	5.17E+01	571500, 122500	10,000	10,000
Nitrogen Oxides	Annual (1993)	1.20E-01	569500, 130500	100	100
Sulfur Oxides	1 hour	5.475	571500, 122500	N/A	655
	3 hour	4.93	571500, 122500	1300	N/A
	24 hour	2.19	571500, 122500	365	260
	Annual (1990)	3.14E-02	587500, 140500	80	60
PM-10	24 hour	7.59E-01	564800, 131200	150	150
	Annual (1992)	8.12E-03	569500, 130500	50	50
Formaldehyde	Annual (1992)	2.77E-05	569500, 130500	N/A	0.077
1,3 -Butadiene	Annual (1993)	7.52E-07	583500, 128500	N/A	0.0036
2 -Hexanone	24 hour	1.07E-03	573400, 126700	N/A	67
2 -Pentanone	24 hour	1.69E-03	573400, 126700	N/A	2300
Acetone	24 hour	2.07E-02	573400, 126700	N/A	5900
Acetonitrile	24 hour	9.80E-03	573400, 126700	N/A	24
Ammonia	24 hour	2.91E-01	567500, 124500	N/A	100
Antimony Compounds	24 hour	6.61E-09	585500, 142500	N/A	1.7
Arsenic Compounds	Annual (1990)	5.17E-11	587500, 140500	N/A	0.00023
Barium Oxide	24 hour	8.05E-09	585500, 142500	N/A	1.7
Benzene	Annual (1993)	5.98E-06	583500, 128500	N/A	0.12
Beryllium Compounds	Annual (1990)	9.22E-13	587500, 140500	N/A	0.00042
Boric Oxide	24 hour	3.16E-04	585500, 142500	N/A	33
Cadmium Compounds	Annual (1990)	4.75E-10	587500, 140500	N/A	0.00056
Calcium Oxide	24 hour	2.23E-05	585500, 142500	N/A	6.7
Chromium Compounds	24 hour	1.52E-06	567500, 124500	N/A	1.7
	Annual (1990)	2.02E-08	587500, 140500	N/A	0.00083
Cobalt Compounds	24 hour	3.20E-09	585500, 142500	N/A	0.17
Ferric Oxide	24 hour	3.01E-06	585500, 142500	N/A	17
Fluoride (as HF)	24 hour	3.01E-01	569500, 124500	N/A	2.9
HCl	24 hour	3.94E-02	585500, 142500	N/A	7
Heptane	24 hour	1.20E-03	573400, 126700	N/A	5500

Table G.4.0.17 Modeling Results for the Phased Implementation Alternative Phase 2 - Operation Phase (cont'd)

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Hexane	24 hour	1.25E-03	573400, 126700	N/A	200
Iodine	24 hour	3.25E-03	585500, 142500	N/A	3.3
Lead Compounds	24 hour	1.07E-07	585500, 142500	N/A	0.5
Manganese Compounds	24 hour	6.47E-07	585500, 142500	N/A	0.4
Methyl Isobutyl Ketone	24 hour	9.03E-05	585500, 144500	N/A	680
N-Butyl Alcohol	24 hour	9.96E-03	585500, 144500	N/A	500
Nickel Compounds	Annual (1990)	5.75E-06	587500, 140500	N/A	0.0021
Nitric Acid	24 hour	9.04E-02	569500, 124500	N/A	17
Nonane	24 hour	6.50E-04	573400, 126700	N/A	3500
Octane	24 hour	6.81E-04	573400, 126700	N/A	4700
Phosphoric Acid, Tributyl Ester	24 hour	1.32E-03	569500, 130500	N/A	3.3
Selenium Compounds	24 hour	1.37E-08	585500, 142500	N/A	0.67
Silver Oxide	24 hour	1.36E-09	585500, 142500	N/A	0.033
Tellurium Trioxide	24 hour	8.99E-10	585500, 142500	N/A	0.33
Toluene	24 hour	9.54E-05	573400, 126700	N/A	400
Uranium Trioxide	24 hour	4.53E-06	585500, 142500	N/A	0.67
Vanadium Pentoxide	24 hour	2.94E-10	585500, 142500	N/A	0.17
Zinc Oxide	24 hour	1.22E-08	585500, 142500	N/A	17
Zirconium Oxide	24 hour	2.00E-06	585500, 142500	N/A	17

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents data year producing the highest impact.

Table G.4.0.18 Modeling Results for the Onsite Disposal Alternative

Pollutant	Averaging period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	83	567500, 130500	40,000	40,000
	8 hour	58	567500, 130500	10,000	10,000
Nitrogen Oxides	Annual (1992)	0.40	583500, 128500	100	100
Sulfur Oxides	1 hour	5.0	567500, 130500	N/A	655
	3 hour	4.5	567500, 130500	1300	N/A
	24 hour	2.0	567500, 130500	365	260
	Annual (1992)	1.0E-02	583500, 128500	80	60
PM-10	24 hour	18	567500, 130500	150	150
	Annual (1992)	0.11	571500, 128500	50	50
Formaldehyde	Annual (19920)	1.1E-04	583500, 128500	N/A	0.077

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents the data year producing the highest impact.

Table G.4.0.19 Modeling Results for the Overpack and Ship Alternative

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Location (x, y) m	Standard or Level	
				Federal ($\mu\text{g}/\text{m}^3$)	State ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	1 hour	39	566600, 130800	40,000	40,000
	8 hour	27	566600, 130800	10,000	10,000
Nitrogen Oxides	Annual (1993)	0.15	583500, 128500	100	100
PM-10	24 hour	1.8	566600, 130800	150	150
	Annual (1993)	2.0E-02	583500, 128500	50	50

Note:

 $\mu\text{g}/\text{m}^3$ = Micrograms per cubic meter

Annual average concentrations shown are the maximum value predicted using data from meteorological years 1989-1993.

The number in parenthesis represents the data year producing the highest impact.

Table G.4.0.20 Radionuclide Modeling Results for the No Action Alternative (Tank Waste)

Radionuclide	Maximum Dose (mrem/yr)	Location	Year ³	Standard	
				State	Federal
Am-241	9.7E-3 ¹	591409, 133908	1993	N/A	N/A
	<i>7.0E-2 ²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Cs-137	2.2E-5 ¹	591500, 136000	1990	N/A	N/A
	<i>1.3E-4 ²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Pu-239, -240	9.1E-3 ¹	591409, 133908	1989	N/A	N/A
	<i>6.3E-2 ²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Sr-90	3.2E-4 ¹	591500, 136000	1989	N/A	N/A
	<i>1.7E-3 ²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
I-129	3.8E-6 ¹	591500, 136000	1989	N/A	N/A
	<i>6.2E-6 ²</i>	<i>583500, 128500</i>	<i>1993</i>	<i>N/A</i>	<i>N/A</i>
Total	1.9E-2 ¹	591409, 133908	1989	N/A	10
	<i>1.4E-1 ²</i>	<i>569500, 130500</i>	<i>1992</i>	25	<i>N/A</i>

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

³ Annual average doses are the maximum value predicted using data from meteorological years 1989-1993. The number in this column represents data the year producing the highest impact.

The results for the No Action alternative (capsules) are included in this table.

Table G.4.0.21 Radionuclide Modeling Results for the Long-Term Management Alternative Phase 1

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	3.2E-02 ¹	582927, 117615	1993	N/A	N/A
	<i>2.7E-01²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Cs-137	6.2E-05 ¹	591409, 133908	1989	N/A	N/A
	<i>4.8E-04²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Pu-239, -240	3.0E-02 ¹	582927, 117615	1993	N/A	N/A
	<i>2.4E-01²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Sr-90	1.3E-03 ¹	582927, 117615	1993	N/A	N/A
	<i>1.0E-02²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
I-129	3.7E-05 ¹	591409, 133908	1989	N/A	N/A
	<i>3.1E-04²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Total	6.3E-02 ¹	582927, 117615	1993	N/A	10
	<i>5.2E-01²</i>	<i>569500, 130500</i>	<i>1992</i>	<i>25</i>	<i>N/A</i>

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Table G.4.0.22 Radionuclide Modeling Results for the Long-Term Management Alternative Phase 2

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	1.7E-02 ¹	591500, 136000	1989	N/A	N/A
	2.5E-02 ²	<i>583500, 128500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Cs-137	4.0E-05 ¹	591500, 136000	1989	N/A	N/A
	6.0E-05 ²	<i>583500, 128500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Pu-239, -240	1.6E-02 ¹	591500, 136000	1989	N/A	N/A
	2.4E-02 ²	<i>583500, 128500</i>	<i>1993</i>	<i>N/A</i>	<i>N/A</i>
Sr-90	6.0E-04 ¹	591500, 136000	1989	N/A	N/A
	8.5E-04 ²	<i>583500, 128500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
I-129	3.8E-05 ¹	591500, 136000	1989	N/A	N/A
	5.7E-05 ²	<i>583500, 128500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Total	3.3E-02 ¹	591500, 136000	1989	N/A	10
	5.0E-02 ²	<i>583500, 128500</i>	<i>1992</i>	25	<i>N/A</i>

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Table G.4.0.23 Radionuclide Modeling Results for the In Situ Fill and Cap Alternative

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	3.3E-02 ¹	582927, 117615	1992	N/A	N/A
	<i>2.7E-01</i> ²	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Cs-137	6.5E-05 ¹	591409, 133908	1989	N/A	N/A
	<i>4.9E-04</i> ²	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Pu-239, -240	3.1E-02 ¹	582927, 117615	1993	N/A	N/A
	<i>2.5E-01</i> ²	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Sr-90	1.3E-03 ¹	582927, 117615	1993	N/A	N/A
	<i>1.0E-02</i> ²	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
I-129	3.9E-05 ¹	591409, 133908	1989	N/A	N/A
	<i>3.1E-04</i> ²	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Total	6.5E-02 ¹	582927, 117615	1993	N/A	10
	<i>5.3E-01</i> ²	<i>569500, 130500</i>	<i>1992</i>	25	<i>N/A</i>

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Table G.4.0.24 Radionuclide Modeling Results for the In Situ Vitrification Alternative

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	9.7E-07 ¹	582927, 117615	1993	N/A	N/A
	7.0E-02 ²	569500, 130500	1992	N/A	N/A
Cs-137	2.2E-03 ¹	591409, 133908	1992	N/A	N/A
	1.4E-04 ²	569500, 130500	1993	N/A	N/A
Pu-239, -240	9.1E-03 ¹	591409, 133908	1989	N/A	N/A
	6.3E-02 ²	569500, 130500	1992	N/A	N/A
Sr-90	3.2E-04 ¹	591500, 136000	1989	N/A	N/A
	1.7E-03 ²	569500, 130500	1992	N/A	N/A
I-129	9.0E-01 ¹	579500, 115215	1992	N/A	N/A
	7.1 ²	569500, 130500	1993	N/A	N/A
Ru-106	3.3E-16 ¹	579500, 115215	1992	N/A	N/A
	2.6E-15 ²	569500, 130500	1993	N/A	N/A
Sm-151	2.9E-10 ¹	579500, 115215	1992	N/A	N/A
	2.3E-09 ²	569500, 130500	1993	N/A	N/A
Tc-99	7.2E-11 ¹	579500, 115215	1992	N/A	N/A
	5.7E-10 ²	569500, 130500	1993	N/A	N/A
Zr-93	2.0E-11 ¹	579500, 115215	1992	N/A	N/A
	1.6E-19 ²	569500, 130500	1993	N/A	N/A
C-14	1.5 ¹	579500, 115215	1992	N/A	N/A
	11.5 ²	569500, 130500	1993	N/A	N/A
Total	2.4 ¹	579500, 115215	1992	N/A	10
	18.8 ²	569500, 130500	1993	25	N/A

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Table G.4.0.25 Radionuclide Modeling Results for the Ex Situ Intermediate Separations Alternative

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	3.5E-02 ¹	591409, 133908	1993	N/A	N/A
	2.7E-01 ²	569500, 130500	1992	N/A	N/A
Cs-137	9.3E-03 ¹	591135, 140168	1990	N/A	N/A
	9.8E-03 ²	593500, 136500	1992	N/A	N/A
Pu-239, -240	3.3E-02 ¹	582927, 117615	1993	N/A	N/A
	2.5E-01 ²	569500, 130500	1992	N/A	N/A
Sr-90	6.1E-03 ¹	591135, 140168	1990	N/A	N/A
	1.3E-02 ²	569500, 130500	1993	N/A	N/A
I-129	2.0E-01 ¹	591135, 140168	1990	N/A	N/A
	2.5E-01 ²	587500, 140500	1990	N/A	N/A
Tc-99	1.3E-07 ¹	591135, 140168	1990	N/A	N/A
	1.6E-07 ²	587500, 140500	1990	N/A	N/A
C-14	3.2E-01 ¹	591135, 140168	1990	N/A	N/A
	4.0E-01 ²	587500, 140500	1990	N/A	N/A
Total	6.0E-01 ¹	591135, 140168	1990	N/A	10
	8.4E-01 ²	569500, 130500	1989	25	N/A

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Results shown are for the operational phase of the alternative. Radionuclide impacts for the construction phase are the same as those shown for the No Action alternative (tank waste). No radionuclides will be emitted from the construction areas.

Table G.4.0.26 Radionuclide Modeling Results for the Ex Situ No Separations Alternative

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	3.5E-02 ¹	582927, 117615	1993	N/A	N/A
	2.7E-01 ²	569500, 130500	1992	N/A	N/A
Cs-137	1.2E-02 ¹	591135, 140168	1990	N/A	N/A
	1.5E-02 ²	587500, 140500	1990	N/A	N/A
Pu-239, -240	3.2E-02 ¹	582927, 117615	1993	N/A	N/A
	2.5E-01 ²	569500, 130500	1992	N/A	N/A
Sr-90	7.7E-03 ¹	591135, 140168	1990	N/A	N/A
	1.2E-02 ²	569500, 130500	1993	N/A	N/A
I-129	2.2E-01 ¹	591135, 140168	1990	N/A	N/A
	2.8E-01 ²	587500, 140500	1990	N/A	N/A
Tc-99	8.8E-07 ¹	591135, 140168	1990	N/A	N/A
	1.1E-06 ²	587500, 140500	1990	N/A	N/A
C-14	3.6E-01 ¹	591135, 140168	1990	N/A	N/A
	4.6E-01 ²	587500, 140500	1990	N/A	N/A
Total	6.6E-01 ¹	591135, 140168	1990	N/A	10
	8.3E-01 ²	587500, 140500	1990	25	N/A

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Results shown are for the operational phase of the alternative. Radionuclide impacts for the construction phase are the same as those shown for the No Action alternative (tank waste). No radionuclides will be emitted from the construction areas.

Radionuclide impacts from the calcination option are identical to those shown on this table, except that the maximum C₁₄ impact is 6.9E-02 mrem/yr. The maximum total radionuclide dose is 4.7E-01.

Table G.4.0.27 Radionuclide Modeling Results for the Ex Situ Extensive Separations Alternative

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	3.7E-02 ¹	582927, 117615	1993	N/A	N/A
	2.7E-01 ²	569500, 130500	1992	N/A	N/A
Cs-137	6.0E-03 ¹	591135, 140168	1990	N/A	N/A
	7.3E-03 ²	587500, 140500	1990	N/A	N/A
Pu-239, -240	3.1E-02 ¹	582927, 117615	1993	N/A	N/A
	2.5E-01 ²	569500, 130500	1992	N/A	N/A
Sr-90	4.3E-03 ¹	591135, 140168	1990	N/A	N/A
	1.2E-02 ²	569500, 130500	1993	N/A	N/A
I-129	2.4E-01 ¹	591135, 140168	1990	N/A	N/A
	2.8E-01 ²	587500, 140500	1990	N/A	N/A
Ru-106	4.1E-12 ¹	591135, 140168	1990	N/A	N/A
	4.9E-12 ²	587500, 140500	1990	N/A	N/A
Sm-151	3.6E-06 ¹	591135, 140168	1990	N/A	N/A
	4.4E-06 ²	587500, 140500	1990	N/A	N/A
Tc-99	8.9E-07 ¹	591135, 140168	1990	N/A	N/A
	1.1E-06 ²	587500, 140500	1990	N/A	N/A
Zr-93	2.5E-07 ¹	591135, 140168	1990	N/A	N/A
	3.0E-07 ²	587500, 140500	1990	N/A	N/A
C-14	3.6E-01 ¹	591135, 140168	1990	N/A	N/A
	4.3E-01 ²	587500, 140500	1990	N/A	N/A
Total	6.6E-01 ¹	591135, 140168	1990	N/A	10
	8.8E-01 ²	569500, 130500	1989	25	N/A

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Results shown are for the operational phase of the alternative. Radionuclide impacts for the construction phase are the same as those shown for the No Action alternative (tank waste). No radionuclides will be emitted from the construction areas.

Table G.4.0.28 Radionuclide Modeling Results for the Ex Situ/In Situ Combination Alternative

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	3.5E-02 ¹	582927, 117615	1993	N/A	N/A
	2.7E-01 ²	569500, 130500	1992	N/A	N/A
Cs-137	8.0E-03 ¹	591135, 140168	1990	N/A	N/A
	1.0E-03 ²	587500, 140500	1990	N/A	N/A
Pu-239, -240	3.3E-02 ¹	591406, 133908	1989	N/A	N/A
	2.5E-01 ²	569500, 130500	1992	N/A	N/A
Sr-90	5.4E-03 ¹	591135, 140168	1990	N/A	N/A
	1.2E-02 ²	569500, 130500	1993	N/A	N/A
I-129	1.8E-01 ¹	591135, 140168	1990	N/A	N/A
	2.2E-01 ²	587500, 140500	1990	N/A	N/A
Tc-99	1.1E-07 ¹	591135, 140168	1990	N/A	N/A
	1.4E-06 ²	587500, 140500	1990	N/A	N/A
C-14	3.1E-01 ¹	591135, 140168	1990	N/A	N/A
	3.8E-01 ²	587500, 140500	1990	N/A	N/A
Total	5.6E-01 ¹	591135, 140168	1990	N/A	10
	8.0E-01 ²	569500, 130500	1989	25	N/A

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Results shown are for the operational phase of the alternative. Radionuclide impacts for the construction phase are the same as those shown for the No Action alternative (tank waste). No radionuclides will be emitted from the construction areas.

Table G.4.0.29 Radionuclide Modeling Results for the Phased Implementation Alternative Phase I

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	1.0E-02 ¹	591409, 133908	1989	N/A	N/A
	<i>7.17E-02</i> ²	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Cs-137	1.4E-03 ¹	591135, 140168	1989	N/A	N/A
	<i>1.8E-03</i> ²	<i>583500, 128500</i>	<i>1993</i>	<i>N/A</i>	<i>N/A</i>
Pu-239, -240	9.8E-03 ¹	591409, 133908	1989	N/A	N/A
	<i>6.3E-02</i> ²	<i>569500, 130500</i>	<i>1992</i>	<i>N/A</i>	<i>N/A</i>
Sr-90	1.0E-03 ¹	591135, 140168	1990	N/A	N/A
	<i>2.0E-03</i> ²	<i>569500, 130500</i>	<i>1993</i>	<i>N/A</i>	<i>N/A</i>
Tc-99	1.2E-09 ¹	591135, 140168	1990	N/A	N/A
	<i>1.6E-09</i> ²	<i>583500, 128500</i>	<i>1993</i>	<i>N/A</i>	<i>N/A</i>
C-14	1.7E-01 ¹	591135, 140168	1990	N/A	N/A
	<i>2.2E-01</i> ²	<i>583500, 128500</i>	<i>1993</i>	<i>N/A</i>	<i>N/A</i>
Total	1.9E-01	591135, 140168	1990	N/A	10
	<i>2.5E-01</i> ²	<i>583500, 128500</i>	<i>1993</i>	<i>25</i>	<i>N/A</i>

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Results shown are for the operational phase of the alternative. Radionuclide impacts for the construction phase are the same as those shown for the No Action alternative (tank waste). No radionuclides will be emitted from the construction areas.

Table G.4.0.30 Radionuclide Modeling Results for the Phased Implementation Alternative Phase 2

Radionuclide	Maximum Dose (mrem/yr)	Location	Year	Standard	
				State	Federal
Am-241	1.24E-02	591135, 140168	1990	N/A	N/A
	<i>7.28E-02</i>	<i>569500, 130500</i>	<i>1993</i>	<i>N/A</i>	<i>N/A</i>
Cs-137	6.93E-03	591135, 140168	1990	N/A	N/A
	<i>8.47E-03</i>	<i>587500, 140500</i>	<i>1990</i>	<i>N/A</i>	<i>N/A</i>
Pu-239, -240	1.307E-02	591135, 140168	1990	N/A	N/A
	<i>6.58E-02</i>	<i>569500, 130500</i>	<i>1993</i>	<i>N/A</i>	<i>N/A</i>
Sr-90	4.11E-03	591135, 140168	1990	N/A	N/A
	<i>5.01E-03</i>	<i>587500, 140500</i>	<i>1990</i>	<i>N/A</i>	<i>N/A</i>
I-129	1.83E-01	591135, 140168	1990	N/A	N/A
	<i>2.28E-01</i>	<i>587500, 140500</i>	<i>1990</i>	<i>N/A</i>	<i>N/A</i>
Tc-99	7.75E-08	591135, 140168	1990	N/A	N/A
	<i>9.54E-08</i>	<i>587500, 140500</i>	<i>1990</i>	<i>N/A</i>	<i>N/A</i>
C-14	4.66E-01	591135, 140168	1990	N/A	N/A
	<i>5.69E-01</i>	<i>587500, 140500</i>	<i>1990</i>	<i>N/A</i>	<i>N/A</i>
Total	6.86E-01	591135, 140168	1990	N/A	10
	<i>8.41E-01</i>	<i>587500, 140500</i>	<i>1990</i>	<i>25</i>	<i>N/A</i>

Notes:

¹ Results in standard type compare the maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

² Results in italic type compare the maximum accumulated dose equivalent at any offsite receptor to the 25 mrem/yr standard contained in WAC 173-480.

Results shown are for the operational phase of the alternative. Radionuclide impacts for the construction phase are the same as those shown for the No Action alternative (tank waste). No radionuclides will be emitted from the construction areas.

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APPENDIX H

SOCIOECONOMIC IMPACT MODELING

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ACRONYMS AND ABBREVIATIONS

D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
M&M	monitoring and maintenance
MSA	Metropolitan Statistical Area
TAR	Tri-Cities Association of Realtors
TPA	Tri-Party Agreement
TWRS	Tank Waste Remediation System
WSDER	Washington State Department of Employment Security
WSDFM	Washington State Department of Financial Management
WSDR	Washington State Department of Revenue

NAMES AND SYMBOLS FOR UNITS OF MEASURE AND RADIOACTIVITY

Length		Area		Volume	
cm	centimeter	ha	hectare	cm ³	cubic centimeter
ft	foot	ac	acre	ft ³	cubic foot
in.	inch	km ²	square kilometer	gal	gallon
km	kilometer	mi ²	square mile	L	liter
m	meter	ft ²	square foot	m ³	cubic meter
mi	mile			ppb	parts per billion
				ppm	parts per million
				yd ³	cubic yard
Mass		Radioactivity			
g	gram	Ci	curie		
kg	kilogram	mCi	millicurie (1.0E-03 Ci)		
mg	milligram	μCi	microcurie (1.0E-06 Ci)		
lb	pound	nCi	nanocurie (1.0E-09 Ci)		
mt	metric ton	pCi	picocurie (1.0E-12 Ci)		

APPENDIX H

SOCIOECONOMIC IMPACT MODELING

H.1.0 INTRODUCTION

This appendix describes the socioeconomic impact modeling for the Tank Waste Remediation System (TWRS) Environmental Impact Statement (EIS) alternatives. It describes the methodology and assumptions used in the modeling effort and provides additional technical information about the analysis. This appendix discusses:

- The development of the baseline Hanford Site employment estimates used to assess the socioeconomic impacts of the EIS alternatives;
- The econometric forecasting model used to project economic variables; and
- Details of the employment projections for the EIS alternatives.

The appendix also includes tables showing socioeconomic impacts for each alternative during each year of the remediation period, analyzed up to the year 2040.

The socioeconomic impact analysis addresses the Tri-Cities Metropolitan Statistical Area (MSA), which encompasses all of Benton and Franklin counties. The analysis does not address impacts on other areas of the region because there are too few Hanford Site employees in the surrounding counties for changes in Hanford Site employment to cause substantial economic impacts there. Historically, only about 7 percent of the total Site work force has lived outside Benton and Franklin counties (Cushing 1995). Most of these employees live in Yakima County, which has a total nonfarm employment of over 65,000 (WSDS 1993b). With Hanford Site employees representing approximately 1 percent of total Yakima County nonfarm employment, the EIS alternatives would have too small an employment impact to warrant detailed analysis.

It was assumed that the schedule for implementing each alternative would meet the applicable Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) milestones (Ecology et al. 1994). There are uncertainties related to waste characterization (Appendix A, Section A.3.0) and waste loading (Appendix B, Section B.3.10 and B.8.0) that could affect the schedules for completing all of the ex situ alternatives. Under conservative case conditions, because of these uncertainties completing the ex situ alternative could require from one to four years beyond the applicable Tri-Party Agreement milestones for low-activity waste. However, there are factors that could compensate for these uncertainties and allow the Tri-Party Agreement schedule to be maintained. For example, it may be possible to achieve a higher percentage of waste loading than projected under the conservative case. Also, larger processing facilities could be constructed or construction schedules could be accelerated, both of which could shorten alternatives' schedules for completion.

Section H.1.1 provides a discussion of the assumptions, data, methodology, and uncertainties directly associated with the development of the baseline scenario used to calculate and compare the impacts of the EIS alternatives. The major uncertainties are associated with the projection of future levels of non-TWRS Hanford Site employment and future overall employment in the Tri-Cities MSA. In both

cases, substantial changes in future overall employment would change each alternative's impact on future Hanford Site employment, Tri-Cities MSA nonfarm employment, population, taxable retail sales, and average home prices. In turn, changes to the population projection would result in comparable changes to each alternative's impact on public services and facilities such as schools, police, and fire (Volume One, Section 5.6). Also, changes to the projection of future Hanford Site employment would result in changes to the analysis of transportation impacts (Volume One, Section 5.10). In each case, however, the changes in future employment would impact all of the alternatives equally. Therefore, while the level of each impact would change, the comparison of the relative impacts among the alternatives would not be affected.

H.1.1 DEVELOPMENT OF THE BASELINE ECONOMIC ESTIMATE

This section describes the assumptions, data, and methodology used to develop the baseline estimate of future economic activity in the Richland, Kennewick, and Pasco (also called the Tri-Cities) MSA. This estimate was used to analyze the socioeconomic impacts of the EIS alternatives.

The socioeconomic impact analysis compares the impacts of the EIS alternatives to an estimate of future economic conditions in the Tri-Cities area, based on Hanford Site employment in the absence of any TWRS activities (except for a phased shutdown of routine tank farm operations). The scenario for future Hanford Site employment that provided the baseline for the impact analysis was calculated using the following method:

- 1) The latest available estimate of total Hanford Site employment was obtained from Hanford Site facility planning personnel (Daly 1995). This estimate assumed implementing the TWRS program as defined by the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) (Ecology et al. 1994).
- 2) Labor requirements were estimated over time to implement the TWRS programs as defined in the Tri-Party Agreement, based on engineering data provided by the Hanford Site maintenance and operations contractor (WHC 1995a). The engineering data was provided for total labor hours by phase of the activity. The EIS contractor then adjusted the labor hours to reflect the final alternatives selected for analysis in the EIS and to ensure consistency in the methodology used to develop labor estimates among the alternatives (Jacobs 1996). This data was then provided for inclusion as inputs into the socioeconomic modeling.
- 3) The labor requirements for the TWRS program were then subtracted from the overall estimate of Hanford Site employment to derive a calculational baseline for Hanford Site employment that excludes remediation of the tank waste.

This calculational baseline for Hanford Site employment (total employment without TWRS employment) then was used in an econometric forecasting model to analyze the socioeconomic impacts of the various EIS alternatives. Figure H.1.1.1 shows both the estimate of total Site employment and the calculational baseline of total Site employment without TWRS employment. All figures and tables in this appendix are provided after page H-13.

Assumptions incorporated into the impact analysis included the following:

- The latest available estimated total Hanford Site employment (including potential TWRS activities as defined in the Tri-Party Agreement) was derived from data for selected years between 1994 and 2025. The intervening years were estimated using straight-line interpolation. For the years subsequent to 2025, a straight-line extrapolation was used, with 2040 as the end year.
- The latest available estimated total Hanford Site employment incorporated planned restructuring of the Hanford Site labor force, including early retirements and reductions in force, as well as new hires expected in 1995 for the Hanford Site environmental restoration contractor, and for the U.S. Department of Energy (DOE), Richland Operations Office. Because plans for labor force restructuring and new hires are under constant review, these estimates are imprecise but are the best currently available.
- The latest available total Hanford Site labor employment estimate includes other (non-TWRS) environmental cleanup and restoration activities, operations and maintenance, research and development (including the Environmental and Molecular Sciences Laboratory and the Laser Interferometer Gravitational Wave Observatory), and facilities management personnel required to operate and maintain the Hanford Site.
- The data on the proposed TWRS program, as defined in the Tri-Party Agreement, provided by the Hanford Site maintenance and operations contractor and the TWRS EIS contractor were used in the following manner. Annual employment data were developed based on engineering projections that allocated estimated labor requirements over the different phases of the project. The annual labor requirements data were then interpolated (or assigned intermediate values) to provide quarterly data, as required by the regression model, to be used to estimate impacts. Because the total Hanford Site employment data were estimated using smoothed interpolations, the TWRS Tri-Party Agreement labor requirements estimates also were smoothed using a 30-quarter moving average before subtracting them from the total Hanford Site employment estimates to obtain the calculational baseline employment estimates. This smoothing was done to maintain consistency between the two data series. Without smoothing the data, the annual fluctuations in the TWRS Tri-Party Agreement data would have been transferred to the calculational baseline estimate, creating a misleading result. However, the smoothed TWRS Tri-Party Agreement data were used only to estimate calculational baseline employment. The socioeconomic impact analysis of the EIS alternatives used unsmoothed data added to the calculational baseline. The calculational baseline estimate used to construct estimates of total Hanford Site employment for each of the proposed EIS alternatives is described in Section H.3.1.
- Routine operations at the tank farms were included in the latest available total Hanford Site employment estimate and in the estimated labor requirements for the TWRS Tri-Party Agreement labor estimate. As envisioned in the Tri-Party Agreement, tank farm routine operations would be phased out over time as remediation occurs. Estimates for employment in routine operations (including phaseouts over time) were incorporated into the labor requirements for the other TWRS EIS alternatives as

described in Section H.3.1. The inclusion of the routine operations labor estimate in the calculational baseline was factored into the labor estimates for each of the alternatives. Routine operations were estimated to require 1,016 full-time equivalent employees. In the calculational baseline, it was assumed that the routine operation activities would phaseout beginning in 2005, with an end to routine operations in 2029. For alternatives with routine operations extending at current levels beyond 2005, the labor required to maintain the 1,016 employment level was added to the alternative labor estimates. This was the case for the No Action, Long-Term Management, and In Situ Fill and Cap alternatives. For other alternatives that ended routine operations prior to 2029, the appropriate level of employment was subtracted for the labor estimate. This was the case for the In Situ Vitrification, Ex Situ/In Situ Combination, and Phased Implementation alternatives.

The calculational baseline estimate of Hanford Site employment is used only to provide a basis for analyzing the impacts of the proposed EIS alternatives. These impacts are measured in terms of percentage changes from the calculational baseline. Neither the calculational baseline nor the impact analysis itself is intended to be a precise forecast of future economic conditions in the Tri-Cities MSA. Any forecast that extends over 40 years can only project current trends and is subject to unpredictable changes in future economic conditions. The Tri-Cities is in the early stages of an economic transition as Site employment decreases. There are currently little definitive data to indicate how successful attempts to diversify the local economy will be in reducing dependence on the Hanford Site, the area's largest single employer. Likewise, any estimates of future Hanford Site employment under any scenario must be considered as estimates rather than definitive data. The calculational baseline estimate, however, provides a consistent projection of one possible path for Hanford Site employment that can be used as the basis for analyzing and comparing the impacts of the EIS alternatives. Changes in future Hanford Site employment or future Tri-City MSA employment would affect the amount of population growth, taxable sales growth, housing price changes, and other socioeconomic factors analyzed in the EIS. However, such future employment changes would affect all EIS alternatives equally and thus would not affect the comparison of the relative impacts of the alternatives.

H.2.0 ECONOMETRIC FORECASTING MODEL METHODOLOGY

Quantitative projections of the impacts of the TWRS EIS alternatives on nonfarm employment, population, housing prices, and taxable retail trade were obtained by regression analysis, using Hanford Site employment as the key independent variable. The regression analysis used data from historical experience to determine the statistical relationship between Hanford Site employment and total Tri-Cities MSA nonfarm employment (1987 to 1993), and the statistical relationship between nonfarm employment and taxable retail sales (1987 to 1993), population (1980 to 1993), and housing market conditions (1980 to 1993). These statistical relationships provide information on the potential impacts of future changes in Hanford Site employment on retail sales, population, and housing market conditions.

Analyzing the impacts of the EIS alternatives required specific estimates of labor hours for implementing each alternative. In each case, these labor hours were estimated based on cost and labor input data supplied by the Hanford Site maintenance and operations contractor (WHC 1995a, c, e, f, g, h, i, j, n) and by the TWRS EIS contractor (Jacobs 1996). The data first were estimated as annual average full-time equivalent employees, then interpolated to obtain quarterly full-time equivalent employees (at annual rates). The labor estimates for the EIS alternatives then were added to the calculational baseline estimate of total Hanford Site employment to obtain total Hanford Site employment estimates under each alternative. The estimates of total Hanford Site employment associated with the EIS alternatives then were used to estimate impacts on nonfarm employment in the Tri-Cities MSA. Because Hanford Site activities do not impact farm employment, the analysis addresses nonfarm employment only. Nonfarm employment then was used to estimate impacts on taxable retail sales and population. Population was used to estimate impacts on housing prices.

The econometric model used to estimate impacts accounts for the "multiplier effect" of Hanford Site jobs on the Tri-Cities economy. For each new job at the Hanford Site, it was estimated that approximately 2.4 jobs would be created in the nonfarm employment sector. These jobs as well as the new Hanford Site jobs then were used in estimating other impacts, including taxable retail sales, population, and housing market conditions.

All equations are linear and were estimated using ordinary least squares. The following sections of this appendix (H.2.1 through H.2.4) document the regression equations used in the quantitative assessments.

H.2.1 EMPLOYMENT

The regression equation for total Tri-Cities MSA nonfarm employment uses quarterly data from the third quarter of 1987 to the fourth quarter of 1993 and has the following explanatory variables:

- X1 = Hanford Site employment (full-time equivalent employees);
- X2 = Time trend;
- X3 = First quarter dummy variable;
- X4 = Lagged Hanford Site employment (one year or four quarters); and
- Y1 = Nonfarm employment.

The time trend starts at one for the third quarter of 1987. Data on Hanford Site employment were obtained from the DOE Richland Operations Office. Data on Tri-Cities MSA employment were obtained from the Washington State Department of Employment Security (WSDS 1993b).

Table H.2.1.1 shows the data used to estimate the regression equation. The T-value for each estimated parameter (a measure of the statistical significance of the estimated parameter, where a T-value greater than two means that there is a high degree of confidence that the true value of the parameter is different than zero) is shown in parentheses. The adjusted R-squared value (a measure of the goodness-of-fit of the estimated equation) is shown immediately after the equation. An adjusted R-squared value of 1.0 indicates a perfect fit.

The estimated equation for employment is:

$$Y1 = 36998.466489 + 2.438843 \cdot X1 + 209.789246 \cdot X2 - 1500.74503 \cdot X3 - 0.822646 \cdot X4$$

(4.574603) (3.103108) (1.039399) (-4.539982) (-4.440990)

Adjusted R-squared: 0.986

Note:

· = Multiplied by

H.2.2 TAXABLE RETAIL SALES

The regression equation for taxable retail sales uses quarterly data from the third quarter of 1987 to the third quarter of 1993 (the latest data available). The equation has the following explanatory variables:

X5 = Time trend;

X6 = Quarterly nonfarm employment at annual rates;

X7 = First quarter dummy variable;

X8 = Fourth quarter dummy variable; and

Y2 = Taxable retail sales.

The data on taxable retail sales were obtained from the Washington State Department of Revenue (WSDR 1993). Table H.2.2.1 shows the data used to estimate the regression equation.

The equation for taxable retail sales is:

$$Y2 = -68.899165 + 5.089547 \cdot X5 + 0.005126 \cdot X6 - 37.779538 \cdot X7 + 0.687021 \cdot X8$$

(-0.613913) (3.652568) (2.471805) (-4.976665) (0.108059)

Adjusted R-squared: 0.964

Note:

· = Multiplied by

H.2.3 POPULATION

The regression equation for population in the Tri-Cities MSA used annual data on population for 1980 to 1993. The explanatory variables are:

X14 = Time trend;

X15 = Annual average nonfarm employment, with a lag of 1 year; and

Y3 = Population.

The time trend starts at one for 1980, although 1980 is not used in the regression because lagged employment is used. The data on population comes from the 1980 and 1990 U.S. Census (DOC 1991) and the Washington State Department of Financial Management (WSDFM 1987-95) for years other than 1980 and 1990. Table H.2.3.1 shows the data used in the regression analysis.

The equation for population is:

$$Y3 = 58107.265102 + 358.944822 \cdot X14 + 1.465489 \cdot X15$$

(3.805755) (1.160945) (5.370630)

Adjusted R-squared: 0.764

Note:

· = Multiplied by

H.2.4 AVERAGE HOME PRICES

The regression equation for the average home price in the Tri-Cities MSA used annual data for 1980 to 1993 (HBA 1994). The explanatory variables are:

X9 = Time trend;

X10 = Population; and

Y4 = Average home price.

Data on home prices were obtained from the Tri-Cities Association of Realtors (TAR 1995).

Table H.2.4.1 shows the data used to estimate the equation.

The equation for the average home price is:

$$Y4 = -176.372436 + 0.508830 \cdot X9 + 0.001653 \cdot X10$$

(-7.901429) (1.755588) (10.435336)

Adjusted R-squared: 0.926

Note:

· = Multiplied by

H.3.0 TWRS EIS ALTERNATIVES IMPACT PROJECTIONS

For each EIS alternative, the economic impact estimates were made using the following four steps.

- 1) Estimates of total Hanford Site employment under the alternative were used to estimate quarterly nonfarm employment.
- 2) Estimated quarterly nonfarm employment was used to estimate quarterly taxable retail sales. Quarterly sales were summed for each year to yield estimated annual taxable retail sales.
- 3) Quarterly sales estimates of nonfarm employment for each year were averaged to estimate the average annual employment for that year. Average annual employment was lagged 1 year and then used to estimate population.
- 4) Annual population estimates were used to estimate average annual home prices.

H.3.1 HANFORD SITE EMPLOYMENT PROJECTIONS

This section provides detail on the development of the employment estimates for the EIS alternatives.

For each alternative, the annual average employment was estimated for each phase of activity based on engineering data and cost estimates provided by the Hanford Site maintenance and operations contractor (WHC a, c, e, f, g, h, i, j, n) and the TWRS EIS contractor (Jacobs 1996).

Employment for each phase of each EIS alternative was divided into three phases for purposes of this analysis. These phases are 1) construction of facilities; 2) facilities operations; and 3) post remediation, including decontamination and decommissioning (D&D) of remediation facilities and monitoring and maintenance (M&M) activities as applicable. Activities for each phase then were divided into waste

retrieval, waste transfer, and waste processing activities. For analytical purposes, the estimates of waste retrieval and processing activities were aggregated into the construction, operations, and post-remediation phases. Each alternative would also involve routine operations of the tank farms that, for all alternatives except No Action and Long-Term Management, would be phased out over time as remediation occurs.

Once total annual average employment for each alternative was derived by combining the annual data for the various phases, the data were converted to quarterly employment by straight line interpolation. Then, the quarterly data for the alternatives were added to the calculational baseline of quarterly average total Hanford Site employment. The resulting estimate of total Hanford Site employment under each alternative then was input to the forecasting model to produce the socioeconomic impact analysis for the Tri-Cities MSA.

No Action Alternative (Tank Waste)

The No Action alternative would have one phase: routine tank farm operations. Figure H.3.1.1 and Table H.3.1.1 show the number of potential full-time equivalent employees by phase under this alternative. The routine tank farm operations phase assumes that routine operations would be maintained at the TWRS program Tri-Party Agreement level through 2005. After 2005, the TWRS program Tri-Party Agreement would involve a steady phaseout of routine operations, while the No Action alternative would maintain routine operations staffing at the 2005 level of just over 1,000 full-time equivalent employees. The difference between routine operations employment under the No Action alternative and under the TWRS program Tri-Party Agreement then was used to calculate total employment for the No Action alternative. Use of the TWRS program Tri-Party Agreement routine operations estimates in the baseline estimate results in the need to add employment to the No Action alternative estimates from 2005 through 2029. The jobs added are only added to maintain employment levels at 1,016 for routine operations.

Long-Term Management Alternative

The Long-Term Management alternative would have two phases: 1) routine tank farm operations; and 2) tank replacement (which would include waste retrieval and transfer activities as well as new tank construction).

The routine operations phase of the Long-Term Management alternative is identical to the routine operations phase for the No Action alternative. The Long-Term Management alternative assumes that the double-shell waste tanks would be replaced every 50 years. The data in Table H.3.1.2 and Figure H.3.1.2 show one such replacement cycle in the 2030's. Future tank replacements would occur beyond the 2040 time frame for the analysis in this EIS.

In Situ Fill and Cap Alternative

This alternative would involve neither a waste retrieval and transfer or a D&D phase. The phases for the In Situ Fill and Cap alternative would include:

- Construction (install fill equipment);

- Fill and Cap operations;
- Post remediation - M&M and tank closure; and
- Routine tank farms operations.

Employment under this alternative would be low; a maximum change from the calculational baseline of less than 150 in the peak year, which is approximately 1 percent of the calculational baseline total Hanford Site employment. Figure H.3.1.3 and Table H.3.1.3 show the number of full-time equivalent employees by phase for the In Situ Fill and Cap alternative. Under this alternative, routine tank farm operations would differ greatly from the TWRS program Tri-Party Agreement estimate. The In Situ Fill and Cap alternative would result in a faster completion of tank waste remediation, which would result in routine operations being phased out sooner. The calculation of Hanford Site employment under the In Situ Fill and Cap alternative includes the difference between routine tank farm operations under the TWRS program defined in the Tri-Party Agreement and routine operations under the In Situ Fill and Cap alternative. This difference would represent a reduction in Hanford Site employment, as compared to the baseline. Because of this difference, the estimate of employment impacts presented in Figure H.3.1.3 and Table H.3.1.3 show a negative estimate of total employment under the alternative from 2023 through 2030. This comparison only represents a negative number of jobs compared to the baseline estimate.

In Situ Vitrification Alternative

The In Situ Vitrification alternative would not involve waste retrieval and transfer but would involve a relatively minor D&D phase. The operations phases for this alternative would include:

- Vitrification facilities construction;
- Vitrification operations;
- Post-remediation activities - M&M, D&D, and tank closure; and
- Routine tank farm operations.

Figure H.3.1.4 and Table H.3.1.4 show the number of full-time equivalent employees by phase for the In Situ Vitrification alternative.

Ex Situ Intermediate Separations Alternative

The Ex Situ Intermediate Separation alternative would involve the following phases:

- Waste retrieval and transfer - construction;
- Waste retrieval and transfer - operations;
- Waste retrieval and transfer - D&D;
- Waste processing - construction;
- Waste processing - operations;
- Post remediation - M&M, D&D, and tank closure; and
- Routine tank farm operations.

Figure H.3.1.5 and Table H.3.1.5 show projected employment for each phase of the alternative. The routine operations phase is identical to the routine operations estimate for the TWRS program as

defined in the Tri-Party Agreement, and it is therefore currently built into the baseline projection as part of the current forecast of Hanford Site employment. Because of this, routine operations were not separately incorporated into the calculated Hanford Site employment for this alternative. Construction employment for both waste retrieval and transfer and for the vitrification facilities would peak in the year 2000 and decline sharply through 2010. Operations employment would begin in 1997, climb steadily from 2001 through 2003, level off for several years, and then climb sharply in 2009 when full-scale waste processing operations would begin. Operations employment would drop off sharply in 2019, at which point post-remediation activities would be conducted.

Ex Situ No Separations Alternative

This alternative's breakdown by phase is the same as for the Ex Situ Intermediate Separations alternative. Figure H.3.1.6 and Table H.3.1.6 show employment for the Ex Situ No Separations alternative by construction, operations, and post-remediation phases. The data show a large spike in construction activity in the period 1997 to 2003. Not only would the level of employment for construction reach almost 4,500 jobs in 2000, but the period of construction activity would be very short, with construction jobs falling to 3,000 in 2001 and below 1,000 by 2003.

Ex Situ Extensive Separations Alternative

Employment would involve the same phases for this alternative as for the Ex Situ Intermediate Separations alternative. As shown in Figure H.3.1.7 and Table H.3.1.7, employment under the alternative would result in two spikes in construction activity. Both spikes would occur during construction of the waste processing facilities. The boom-bust cycle reflected by the two spikes would result in substantial economic impacts because of the transient nature of crews working on large construction projects. The Tri-Cities MSA experienced similar conditions in the early 1980's with the Washington Public Supply System nuclear project (as noted in Section 4.6).

Ex Situ/In Situ Combination Alternative

This alternative is a combination of the In Situ Fill and Cap alternative and the Ex Situ Extensive Separations alternative. Approximately 70 tanks would have their waste retrieved, transferred, and processed as described for the Ex Situ Intermediate Separations alternative, with the remaining tanks undergoing fill and cap construction and operations activities as described for the In Situ Fill and Cap alternative. The breakdown by phases for Ex Situ/In Situ Combination alternative would be as follows:

In Situ Fill and Cap Component

- Construction (install fill equipment);
- Fill and cap operations;
- Post remediation M&M, D&D; and tank closure; and
- Routine tank farm operations.

Ex Situ Intermediate Separations Component

- Waste retrieval and transfer - construction;
- Waste retrieval and transfer - operations;
- Waste retrieval and transfer - D&D;
- Waste processing - construction;
- Waste processing - operations;
- Post remediation M&M, D&D, and tank closure; and
- Routine tank farm operations.

Figure H.3.1.8 and Table H.3.1.8 show estimated employment under the Ex Situ/In Situ Combination alternative by project phase. Construction activity, including both waste retrieval and transfer and waste processing facilities, would peak in 2000, and then begin a steady decrease through 2010. After several years of level employment, construction activity then would fall steadily until it ends in 2018. Operations, including both transfer and retrieval and waste processing, would begin to increase in the late 1990's with a fairly level period between 2003 and 2009. This would be followed by a large increase to a peak level in 2010, when waste processing would reach its full operational status. After 2018, operations would decline sharply when the post-remediation activity (including tank closure and D&D of facilities) would occur. Except for minimal M&M activities, total Hanford Site employment for the Ex Situ/In Situ Combination alternative and the calculational baseline would converge by 2030.

Phased Implementation Alternative

The Phased Implementation alternative differs from the other alternatives, and this difference is reflected in the economic impact analysis. Phased Implementation would involve a demonstration phase (Phase 1) and a full-scale treatment phase (Phase 2). The demonstration phase would involve one combined separations and LAW facility and one combined separations, LAW vitrification, and HLW vitrification facility. After completing the demonstration phase, a combined separations, LAW and HLW full-scale vitrification facility similar to the Ex Situ/In Situ Combination alternative would be built, together with waste retrieval and transfer facilities. The demonstration facilities would continue to operate through 2023, while the full-scale facilities would operate through 2025. The economic impact analysis is divided into two parts; Phase 1 covers the demonstration phase only, and the total alternative covers the entire Phased Implementation alternative.

Labor force requirements for the Phased Implementation alternative were based on the Ex Situ Intermediate Separations alternative, scaled for the reduced size of the facilities, and include construction, operation, and post-remediation labor force for the two plants. In addition, there was a further 15 percent reduction in labor force requirement based on an improved overall efficiency in operating personnel operations during the first phase. The alternative's construction labor force was also subject to a 15 percent reduction under the assumption that the alternative would be performed to conform to industry standards and U.S. Environmental Protection Agency, Nuclear Regulatory Commission, and Occupational Safety and Health Administration requirements, rather than DOE Orders, except in areas specific to the handling and treatment of high-level waste and defense-related special materials.

Phase 1

Phase 1 of the Phased Implementation alternative would consist of construction, operations, and post remediation (including D&D).

Because this alternative would involve a reduced-scale demonstration and terminate in 2013 after processing only a portion of the tank waste, routine operations are assumed to be the same as under the calculational baseline and are not separately identified. Also, M&M activities are not included because

of the limited duration of the alternative. A small number of workers would be involved in transferring waste from the tanks to the treatment facility and are included in the operations phase labor force projections. Figure H.3.1.9 and Table H.3.1.9 show the labor force projections for each element of the alternative.

Total Alternative

The total Phased Implementation alternative would consist of construction, operations, post remediation (including D&D and M&M), and routine operations.

Labor requirements for the total Phased Implementation alternative track the Phase 1 labor requirements through 2003. Construction of waste retrieval and transfer facilities for Phase 2 would begin in 2004. Construction of the waste treatment facility would begin in 2005. Unlike Phase 1, operation of the demonstration treatment facility would continue through 2023. Operation of the Phase 2 waste retrieval and treatment facilities would extend through 2025. D&D of the waste retrieval and transfer facilities would begin in 2015 and extend through 2027, while D&D of the waste treatment facilities would begin in 2022 and extend through 2030. Tank closure would begin in 2016 and conclude in 2039. Routine operations virtually would be the same as in the calculational baseline, except for some accelerated reduction in the labor force after 2020. Figure H.3.1.10 and Table H.3.1.10 show the labor force projections for each phase.

Capsule Alternatives

The maximum number of employees that would be involved in implementing any of the capsule alternatives would be 47 employees in the peak year. This low level of employment will not have a measurable impact on current and future socioeconomic conditions. For this reason, the socioeconomic impacts of capsule alternatives were not modeled. However, where appropriate, data regarding employment under the alternatives are presented in Section 5.6.

H.3.2 DATA TABLES FOR IMPACTS OF TWRS EIS ALTERNATIVES

The annual impacts of the EIS alternatives are presented in the following data tables.

Hanford Site Employment:

Table H.3.2.1 Hanford Site Employment with No Action, Long-Term Management, and In Situ Fill and Cap Alternatives, 1994 to 2040

Table H.3.2.2 Hanford Site Employment with In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives, 1994 to 2040

Table H.3.2.3 Hanford Site Employment with Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives, 1994 to 2040

Tri-Cities Nonfarm Employment:

Table H.3.2.4 Tri-Cities MSA Nonfarm Employment with No Action, Long-Term Management, and In Situ Fill and Cap Alternatives, 1994 to 2040

Table H.3.2.5 Tri-Cities MSA Nonfarm Employment with In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives, 1994 to 2040

Table H.3.2.6 Tri-Cities MSA Nonfarm Employment with Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives, 1994 to 2040

Tri-Cities Population:

Table H.3.2.7 Tri-Cities MSA Population with No Action, Long-Term Management, and In Situ Fill and Cap Alternatives, 1994 to 2040

Table H.3.2.8 Tri-Cities MSA Population with In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives, 1994 to 2040

Table H.3.2.9 Tri-Cities MSA Population with Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives, 1994 to 2040

Tri-Cities Taxable Retail Sales:

Table H.3.2.10 Tri-Cities MSA Taxable Retail Sales with No Action, Long-Term Management, and In Situ Fill and Cap Alternatives, 1994 to 2040

Table H.3.2.11 Tri-Cities MSA Taxable Retail Sales with In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives, 1994 to 2040

Table H.3.2.12 Tri-Cities MSA Taxable Retail Sales with Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives, 1994 to 2040

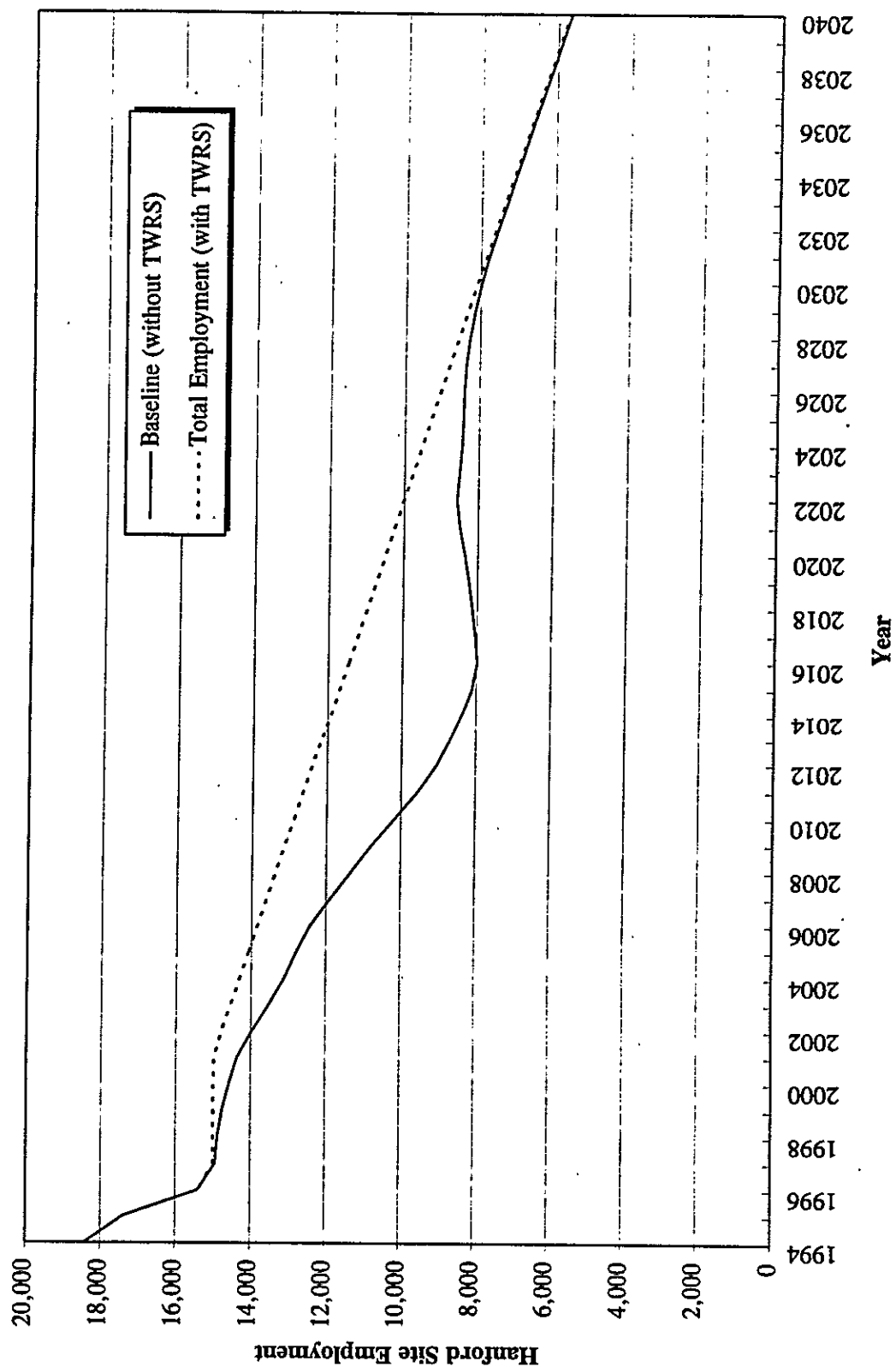
Tri-Cities Housing Prices:

Table H.3.2.13 Tri-Cities MSA Home Prices with No Action, Long-Term Management, and In Situ Fill and Cap Alternatives, 1994 to 2040

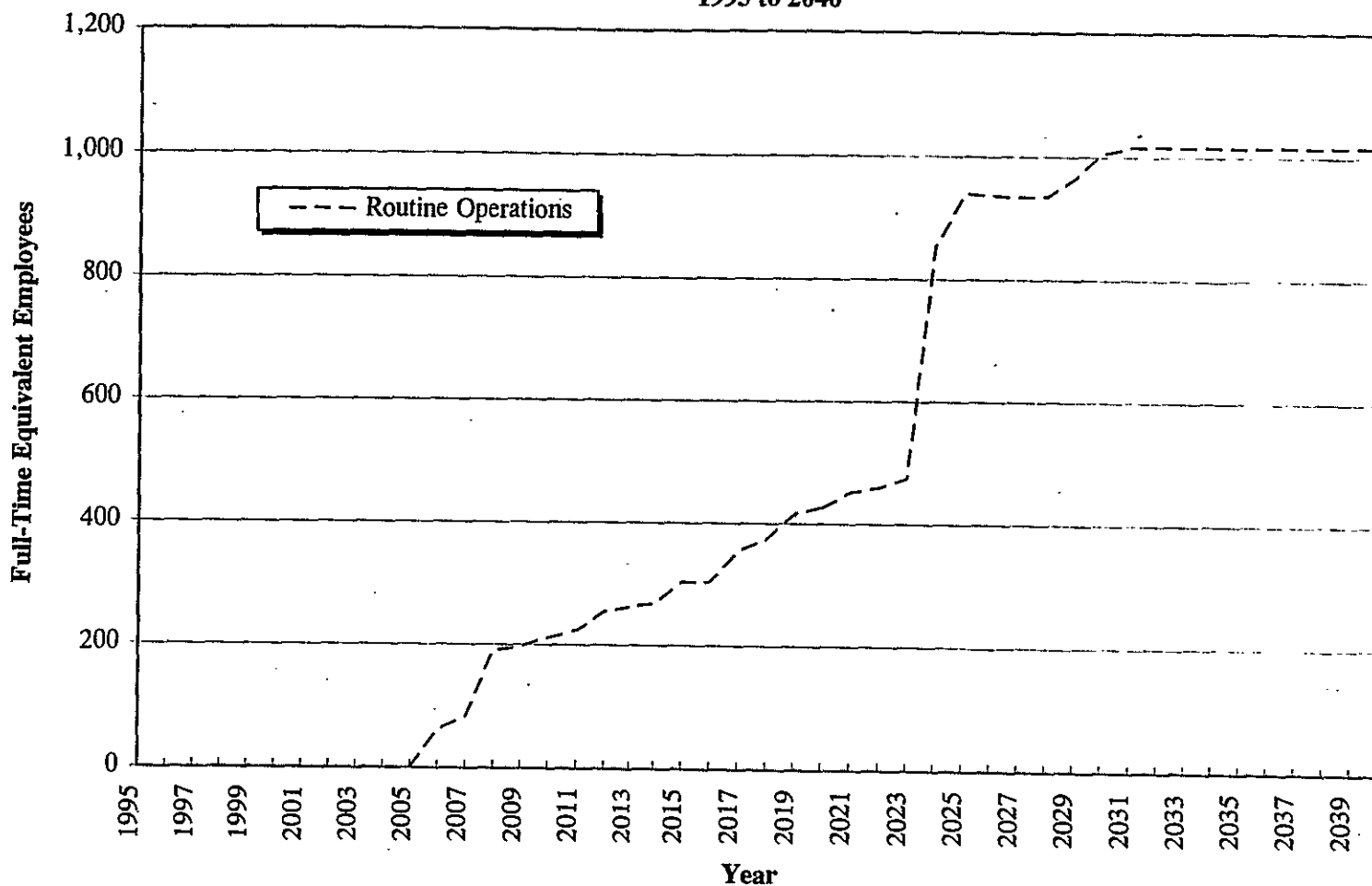
Table H.3.2.14 Tri-Cities MSA Home Prices with In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives, 1994 to 2040

Table H.3.2.15 Tri-Cities MSA Home Prices with Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives, 1994 to 2040

Figure H.1.1.1 Estimated Hanford Site Employment and Calculational Baseline Employment Estimate, 1994 to 2040

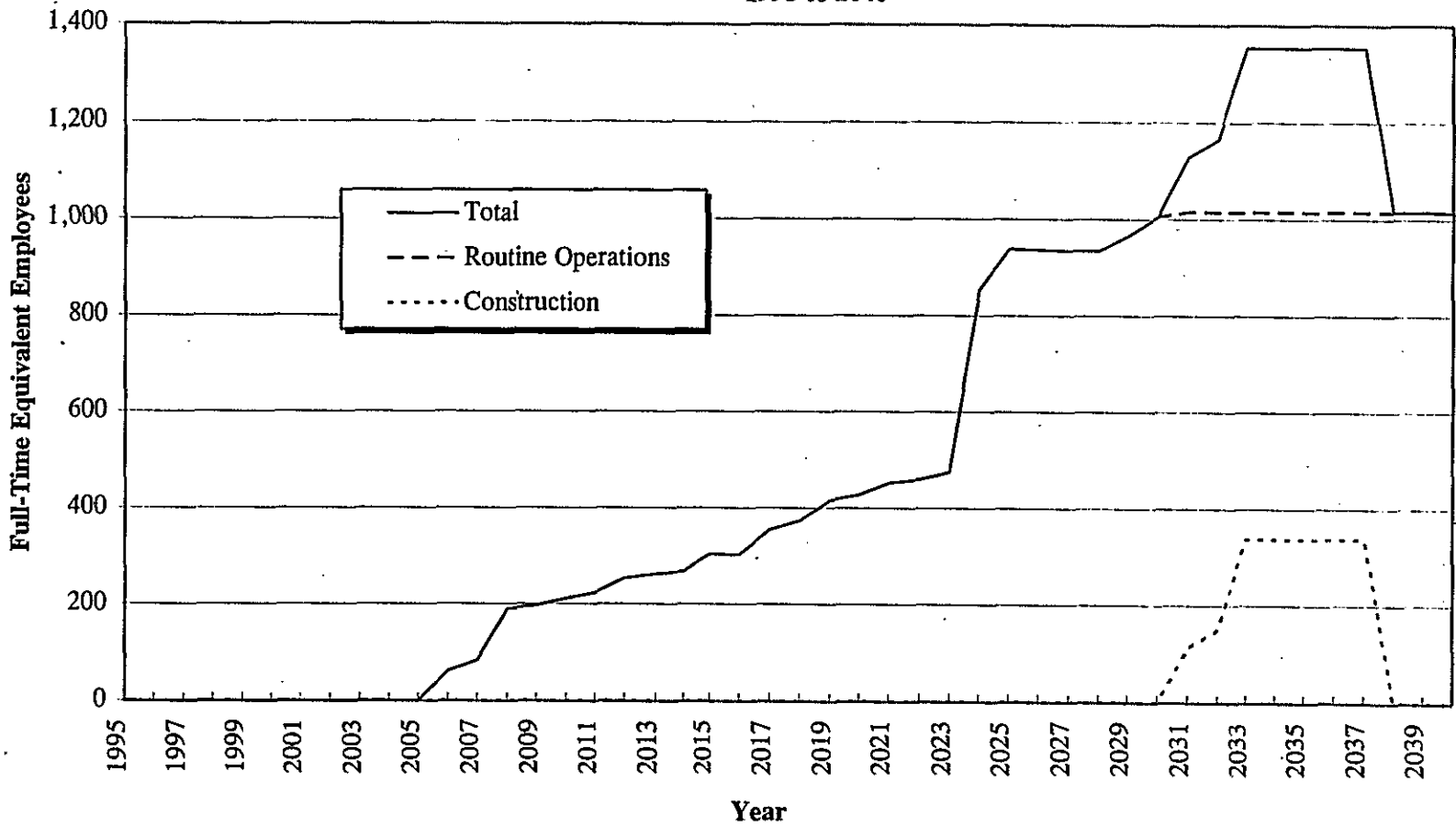


**Figure H.3.1.1 Full-Time Equivalent Employees (Change from Baseline Estimate) -
No Action Alternative,
1995 to 2040**



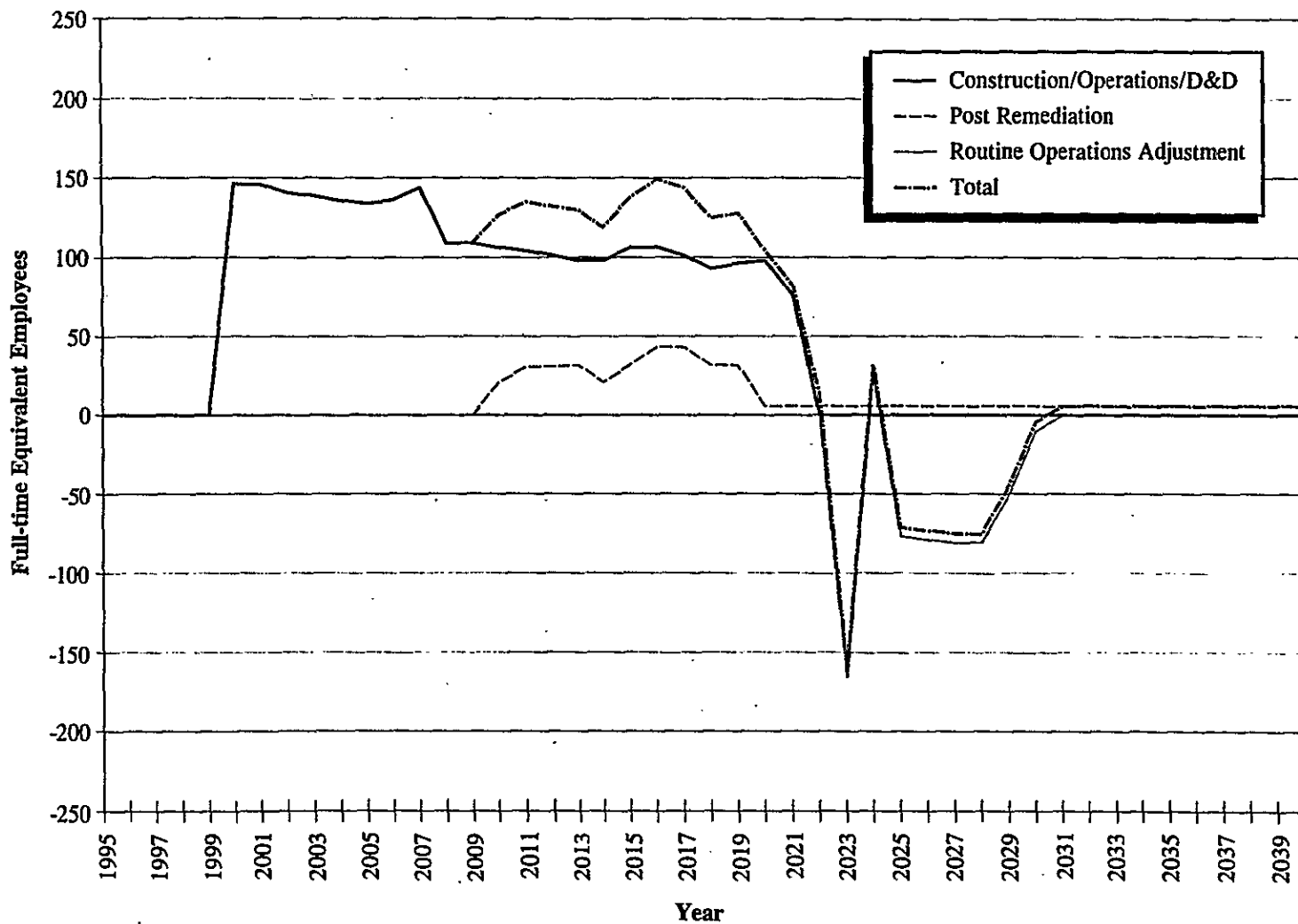
Routine operations are those in addition to routine operations labor requirements under the TWRS program Tri-Party Agreement estimate, which includes approximately 1,000 employees for routine operations through 2005 and a phaseout of employment through 2029. The employment estimate assumes employment for routine operations would continue at 1995 levels through 2040.

**Figure H.3.1.2 Full-Time Equivalent Employees (Change from Baseline Estimate) -
Long-Term Management Alternative,
1995 to 2040**



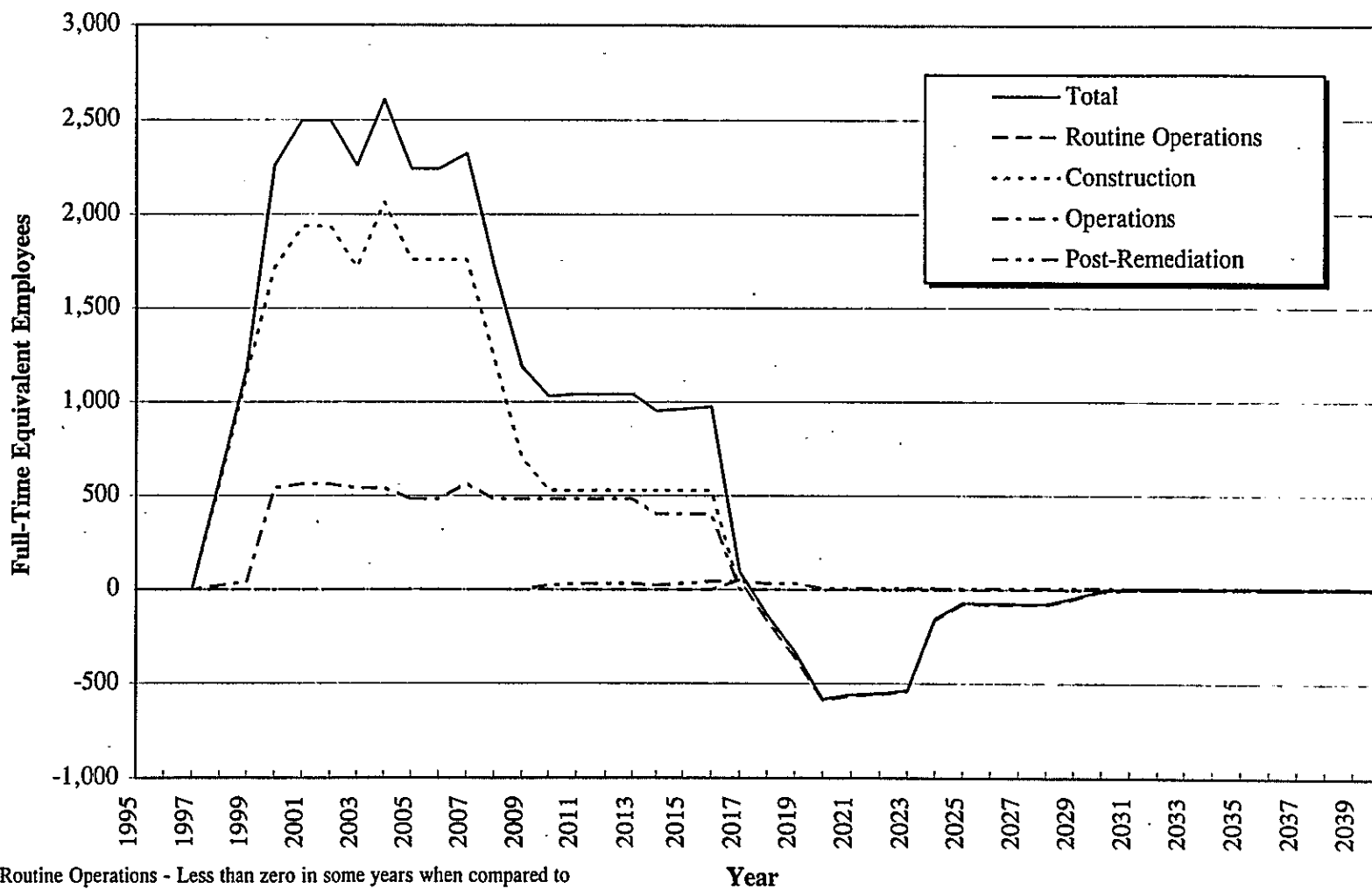
Routine operations are those in addition to routine operations labor requirements under the TWRS program Tri-Party Agreement estimate, which includes approximately 1,000 employees for routine operations through 2005 and a phaseout of employment through 2029. The employment estimate assumes employment for routine operations would continue at 1995 levels through 2040.

**Figure H.3.1.3 Full-Time Equivalent Employees (Change from Baseline Projection) -
In Situ Fill and Cap Alternative, 1995 to 2040**



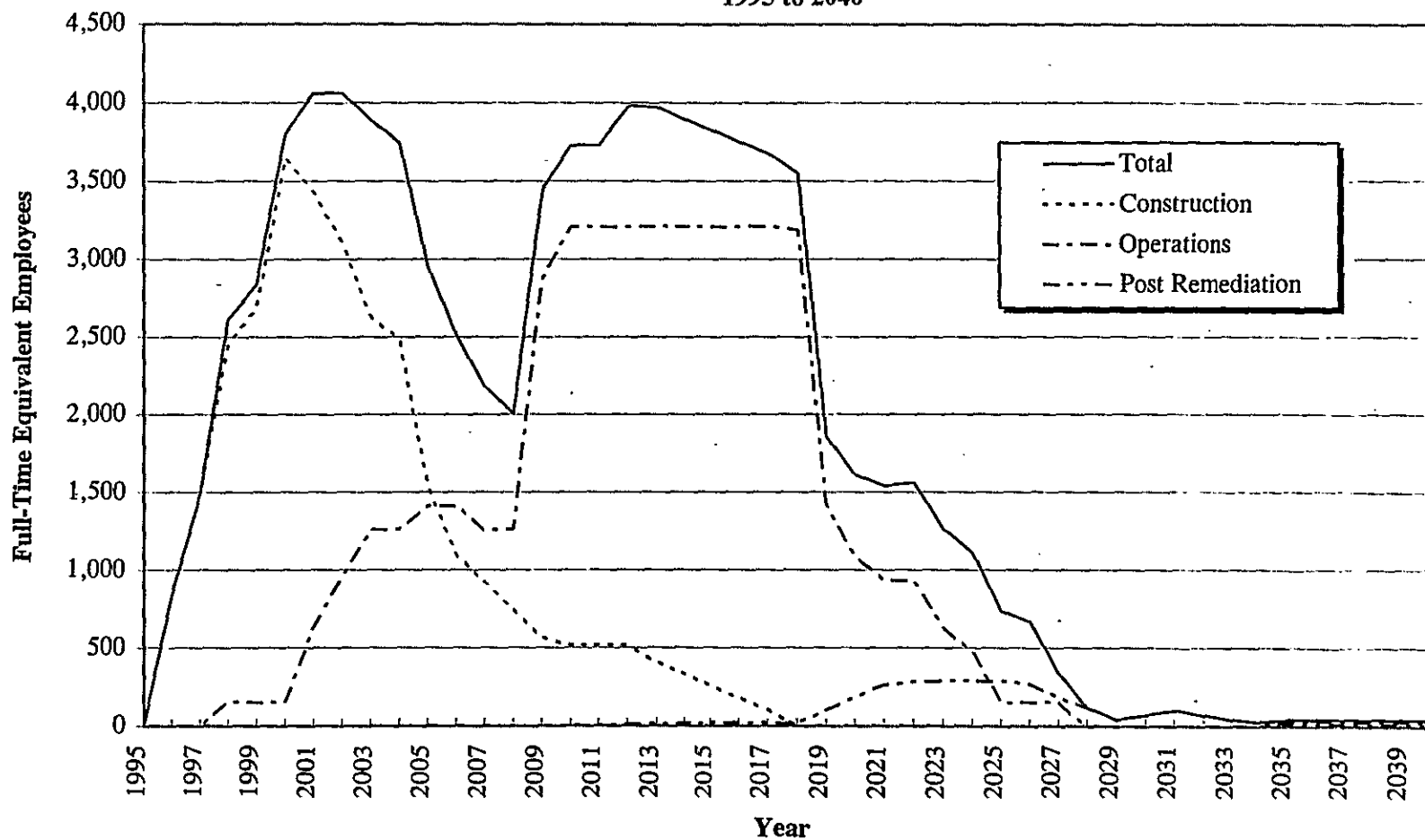
NOTE: Negative numbers result from phase out of routine operations on an earlier schedule than included in the TWRS program Tri-Party Agreement estimate.

**Figure H.3.1.4 Full-Time Equivalent Employees (Change from Baseline Estimate) -
In Situ Vitrification Alternative,
1995 to 2040**

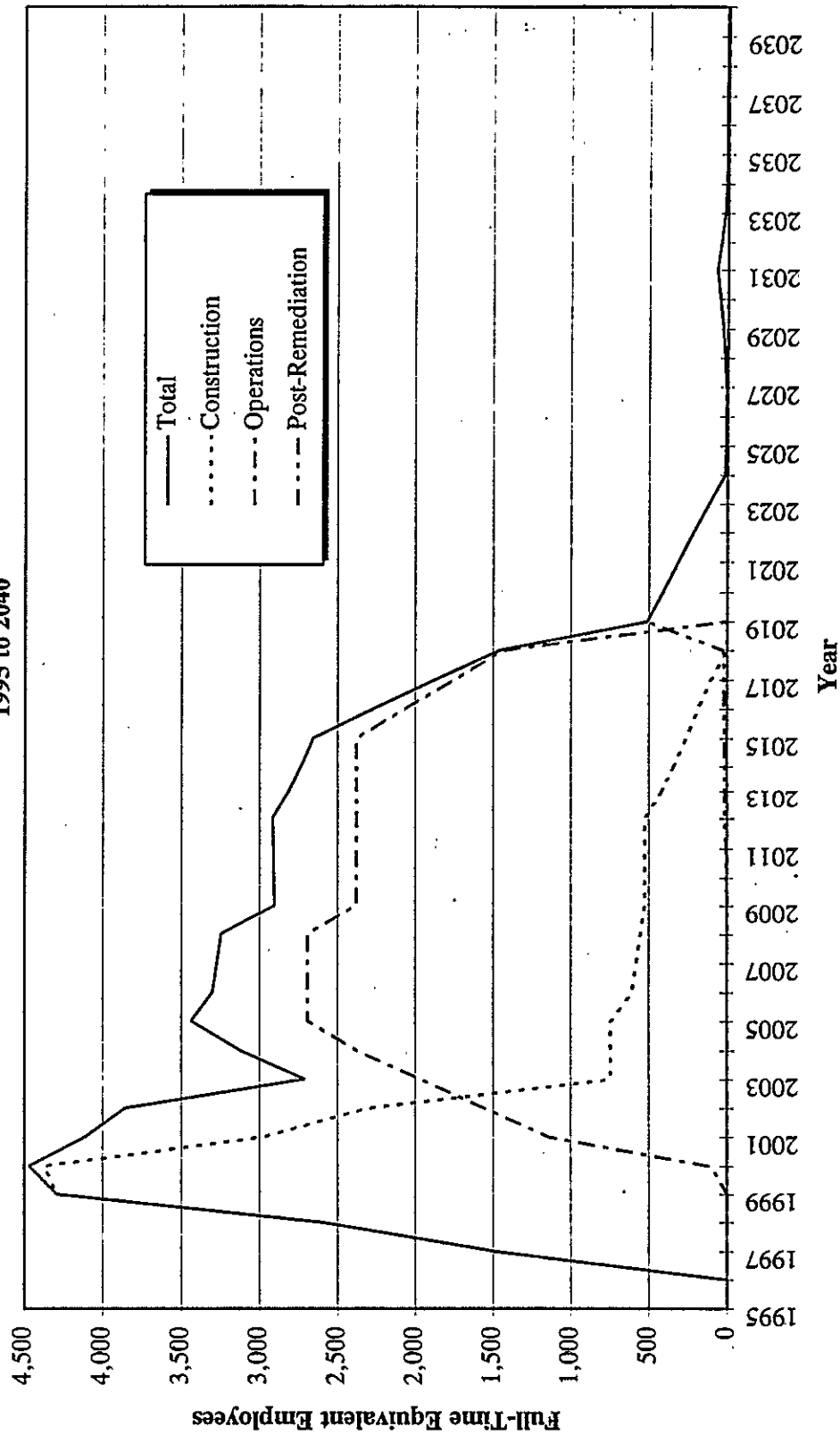


Routine Operations - Less than zero in some years when compared to the total employment, which includes routine tank farm operations in the TWRS program Tri-Party Agreement estimate.

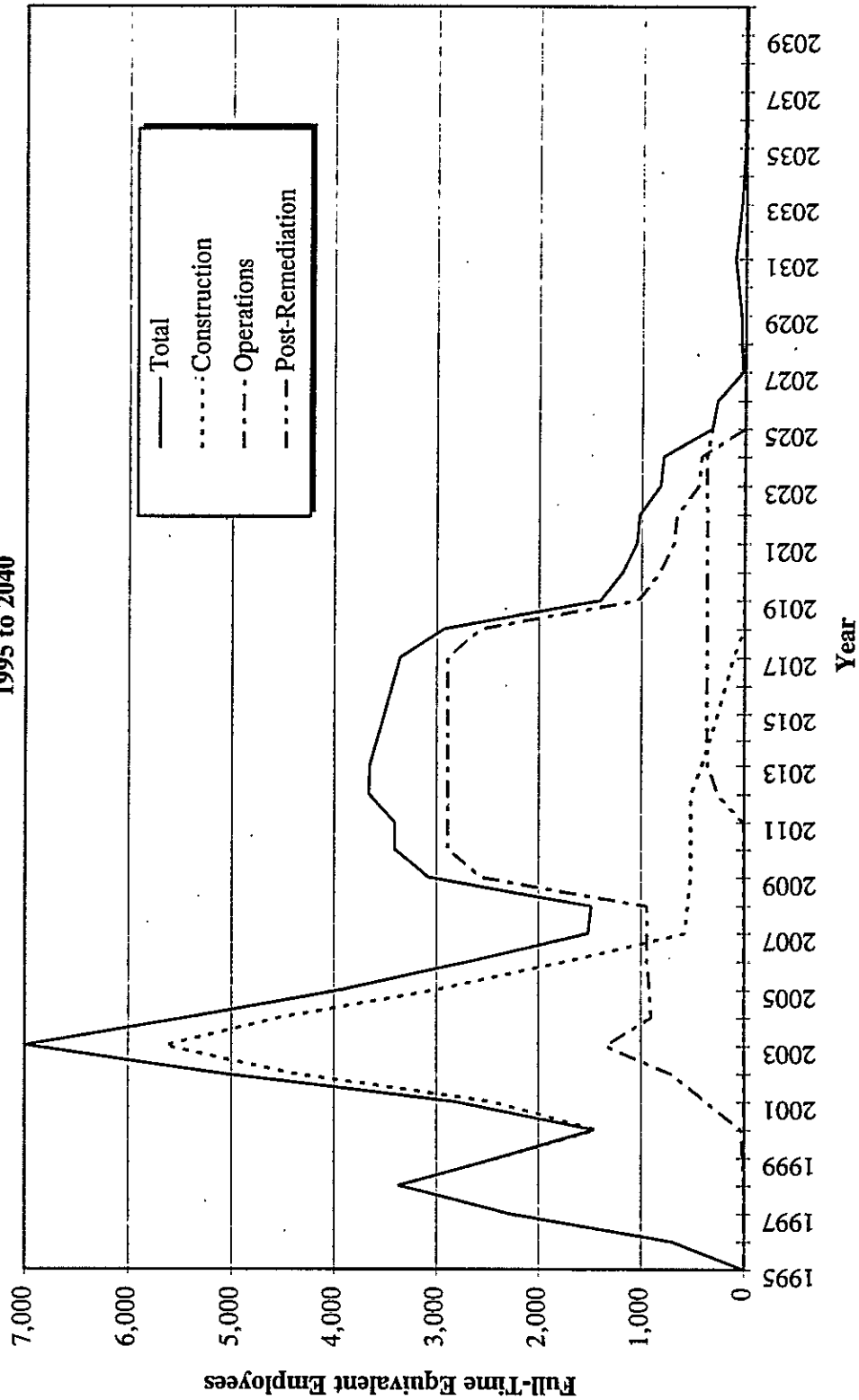
**Figure H.3.1.5 Full-Time Equivalent Employees (Change from Baseline Estimate) -
Ex Situ Intermediate Separations Alternative,
1995 to 2040**



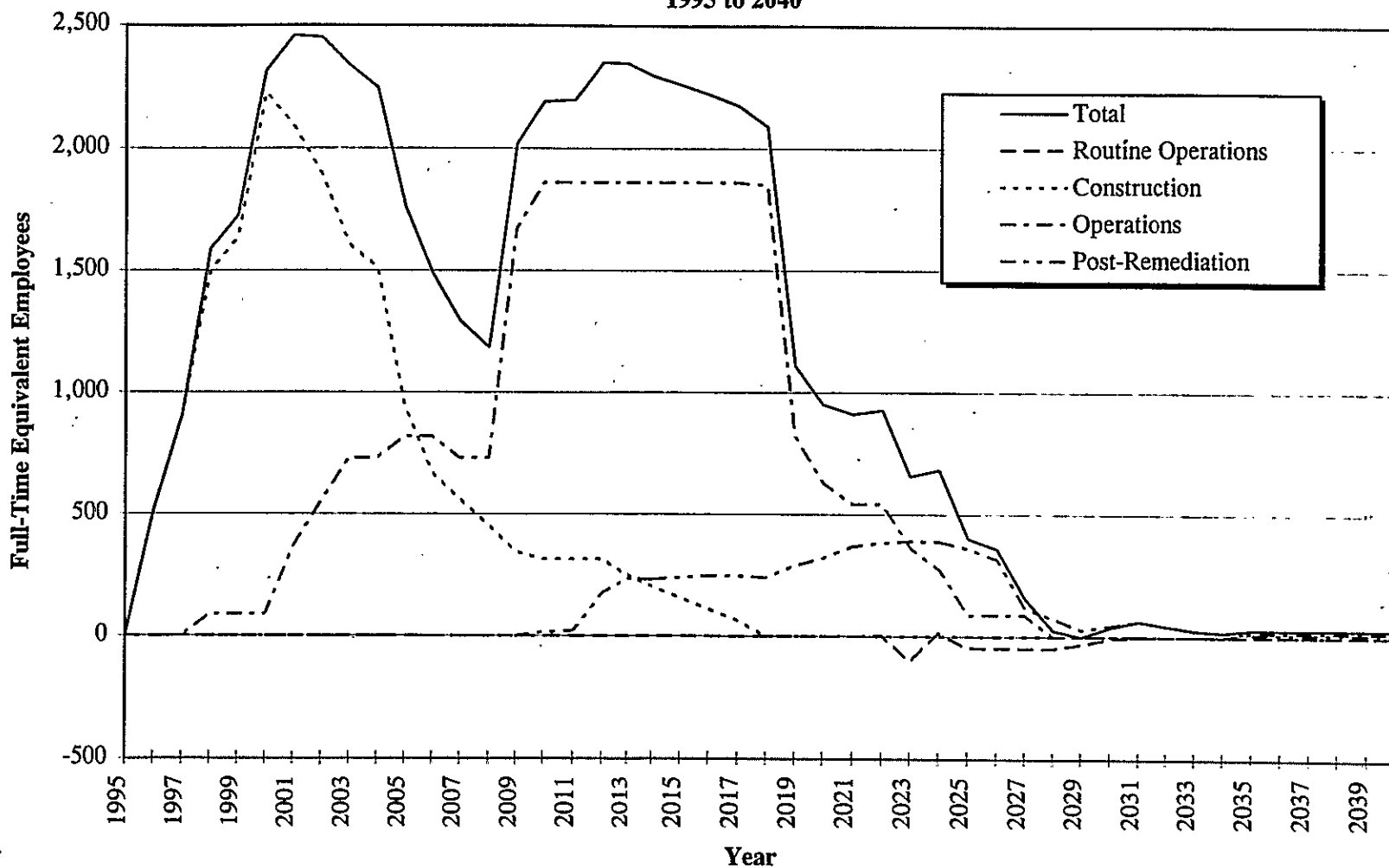
**Figure H.3.1.6 Full-Time Equivalent Employees (Change from Baseline Estimate) -
Ex Situ No Separations Alternative,
1995 to 2040**



**Figure H.3.1.7 Full-Time Equivalent Employees (Change from Baseline Estimate) -
Ex Situ Extensive Separations Alternative,
1995 to 2040**

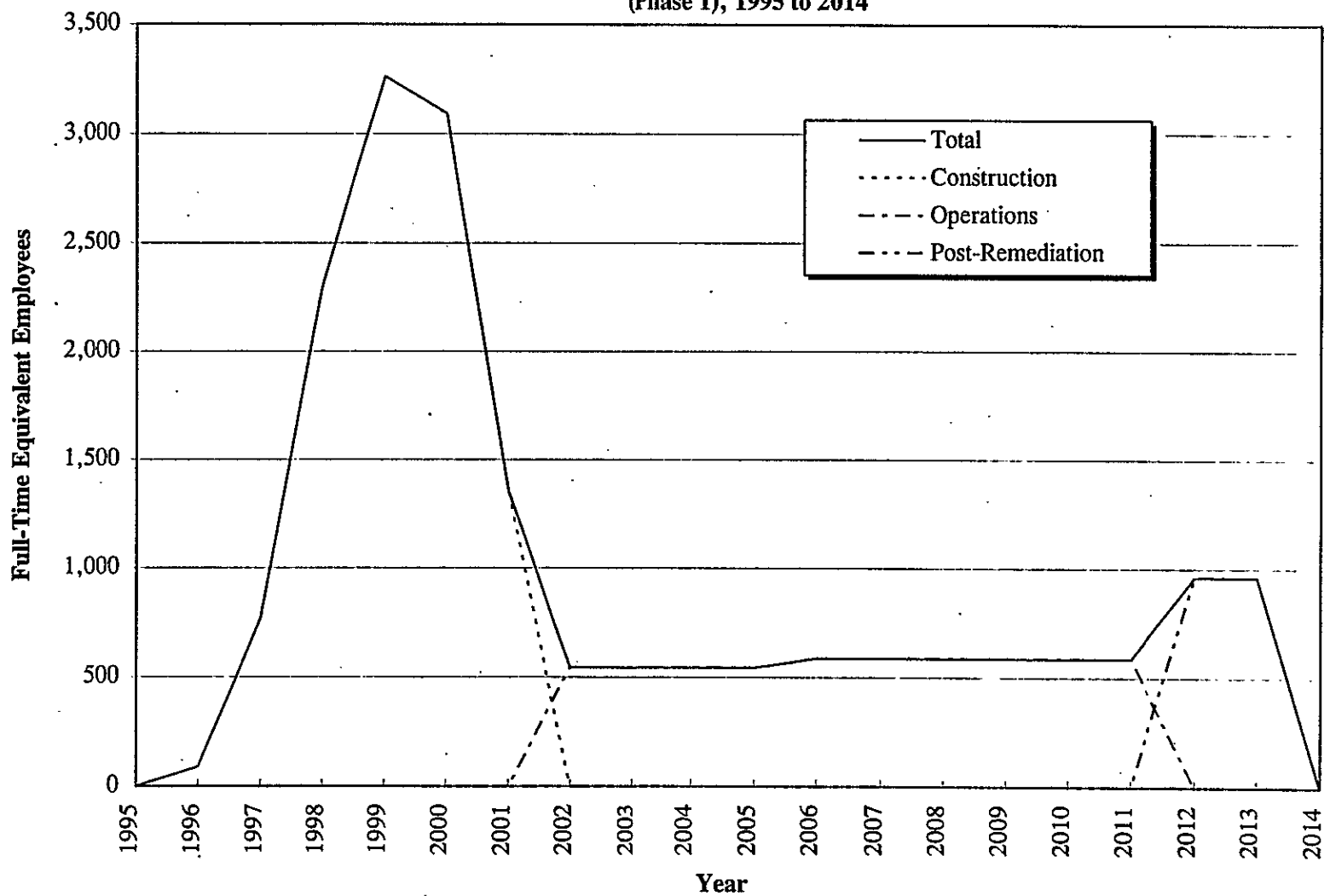


**Figure H.3.1.8 Full-Time Equivalent Employees (Change from Baseline Estimate) -
Ex Situ/In Situ Combination Alternative,
1995 to 2040**

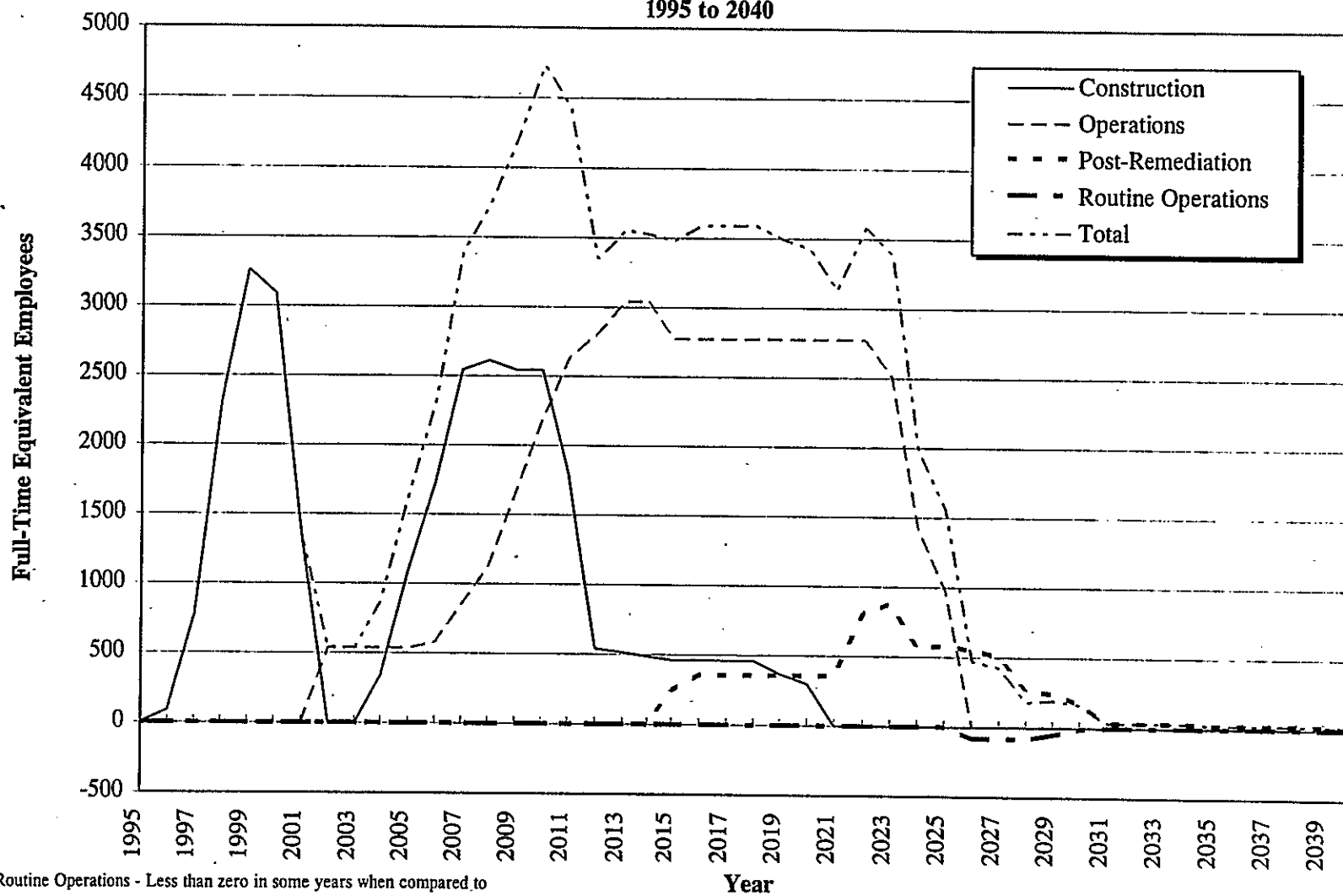


Routine Operations - Less than zero in some years when compared to total employment for routine tank farm operations in the TWRS program Tri-Party Agreement estimate

**Figure H.3.1.9 Full-Time Equivalent Employees (Change from Baseline Estimate) -
Phased Implementation Alternative,
(Phase 1), 1995 to 2014**



**Figure H.3.1.10 Full-Time Equivalent Employees (Change from Baseline Estimate) -
Phased Implementation (Total Alternative),
1995 to 2040**



Routine Operations - Less than zero in some years when compared to the total employment, which precludes routine tank farm operations in the TWRS program Tri-Party Agreement estimate.

Table H.2.1.1 Regression Data for Nonfarm Employment in the Tri-Cities MSA

Y1	X1	X2	X3	X4
55,537	12,400	1	0	14,500
55,237	12,200	2	0	14,100
55,033	12,100	3	1	13,500
57,433	12,300	4	0	12,900
58,233	12,700	5	0	12,400
58,600	13,000	6	0	12,200
59,233	13,300	7	1	12,100
63,033	13,800	8	0	12,300
62,767	14,000	9	0	12,700
62,933	14,200	10	0	13,000
61,533	14,400	11	1	13,300
64,967	14,800	12	0	13,800
64,967	15,000	13	0	14,000
65,800	15,100	14	0	14,200
64,967	15,500	15	1	14,400
68,067	16,000	16	0	14,800
67,433	16,100	17	0	15,000
67,567	16,200	18	0	15,100
66,770	16,500	19	1	15,500
69,830	17,200	20	0	16,000
70,300	17,300	21	0	16,100
70,900	17,800	22	0	16,200

Notes:

Y1 = Nonfarm employment

X1 = Hanford Site employment (full-time equivalent employees)

X2 = Time trend

X3 = First quarter dummy variable

X4 = Lagged Hanford Site employment (one year or four quarters)

Table H.2.2.1 Regression Data for Taxable Retail Sales in the Tri-Cities MSA

Y2	X5	X6	X7	X8
239	1	57,390	0	0
234	2	57,413	0	1
203	3	54,837	1	0
238	4	56,343	0	0
238	5	55,537	0	0
250	6	55,237	0	1
220	7	55,033	1	0
270	8	57,433	0	0
268	9	58,233	0	0
282	10	58,600	0	1
252	11	59,233	1	0
309	12	63,033	0	0
326	13	62,767	0	0
321	14	62,933	0	1
286	15	61,533	1	0
325	16	64,967	0	0
335	17	64,967	0	0
347	18	65,800	0	1
316	19	64,967	1	0
384	20	68,067	0	0
373	21	67,433	0	0
407	22	67,567	0	1
338	23	66,770	1	0
428	24	69,830	0	0
447	25	70,300	0	0

Notes:

Y2 = Taxable retail sales (\$ Millions)

X5 = Time trend

X6 = Nonfarm employment

X7 = First quarter dummy variable

X8 = Fourth quarter dummy variable

Table H.2.3.1 Regression Data for Population in the Tri-Cities MSA

Y3	X14	X15
144,469	1	not applicable
150,100	2	58,710
147,900	3	63,940
144,700	4	58,860
144,000	5	55,360
140,900	6	52,870
139,300	7	54,020
139,600	8	55,230
139,600	9	56,970
138,300	10	55,400
150,030	11	57,325
153,400	12	61,992
157,700	13	64,317
163,900	14	67,008

Notes:

Y3 = Population

X14 = Time trend

X15 = Lagged nonfarm employment

Table H.2.4.1 Regression Data for Average Home Prices in the Tri-Cities MSA

Y4	X9	X10
65.1	1	144,469
73.1	2	150,100
66.8	3	147,900
64.8	4	144,700
62.6	5	144,000
60.9	6	140,900
60.0	7	139,300
59.6	8	139,600
58.8	9	139,600
59.7	10	138,300
68.3	11	150,030
78.7	12	153,400
93.8	13	157,700
106.6	14	163,900

Notes:

Y4 = Average home price (\$ Thousands)

X9 = Time trend

X10 = Population

**Table H.3.1.1 Full-Time Equivalent Employees by Phase (Change from Baseline Estimate) -
No Action Alternative, 1995 to 2040**

Year	Routine Operations (Difference from Baseline) ^{1, 2}
1995	0
1996	0
1997	0
1998	0
1999	0
2000	0
2001	0
2002	0
2003	0
2004	0
2005	0
2006	61
2007	83
2008	190
2009	197
2010	212
2011	224
2012	254
2013	263
2014	268
2015	304
2016	303
2017	355
2018	374
2019	416
2020	428
2021	453
2022	460
2023	475
2024	854
2025	939
2026	937
2027	935
2028	935
2029	966
2030	1,006
2031	1,016
2032	1,016
2033	1,016
2034	1,016
2035	1,016
2036	1,016
2037	1,016
2038	1,016
2039	1,016
2040	1,016

Notes:

¹ Hanford Site baseline employment is shown on Table H.3.2.1.

² Routine operations are those in addition to routine operations labor requirements under the TWRS program Tri-Party Agreement estimate, which includes approximately 1,000 employees for routine operations through 2005 and a phaseout of employment through 2029. The employment estimate assumes employment for routine operations would continue at 1995 levels through 2040.

**Table H.3.1.2 Full-Time Equivalent Employees by Phase (Change from Baseline Estimate) -
Long-Term Management Alternative, 1995 to 2040**

Year	Routine Operations (Difference from Baseline) ^{1,2}	New Tank Construction	Total
1995	0	0	0
1996	0	0	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
2001	0	0	0
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	61	0	61
2007	83	0	83
2008	190	0	190
2009	197	0	197
2010	212	0	212
2011	224	0	224
2012	254	0	254
2013	263	0	263
2014	268	0	268
2015	304	0	304
2016	303	0	303
2017	355	0	355
2018	374	0	374
2019	416	0	416
2020	428	0	428
2021	453	0	453
2022	460	0	460
2023	475	0	475
2024	854	0	854
2025	939	0	939
2026	937	0	937
2027	935	0	935
2028	935	0	935
2029	966	0	966
2030	1,006	0	1,006
2031	1,016	113	1,129
2032	1,016	150	1,166
2033	1,016	338	1,354
2034	1,016	338	1,354
2035	1,016	338	1,354
2036	1,016	338	1,354
2037	1,016	338	1,354
2038	1,016	0	1,016
2039	1,016	0	1,016
2040	1,016	0	1,016

Notes:

¹ Hanford Site Baseline employment is shown on Table H.3.2.1.

² Routine operations are those in addition to routine operations labor requirements under the TWRS program Tri-Party Agreement estimate, which includes approximately 1,000 employees for routine operations through 2005 and a phaseout of employment through 2029. The employment estimate assumes employment for routine operations would continue at 1995 levels through 2040.

**Table H.3.1.3 Full-Time Equivalent Employees by Phase (Change from Baseline Estimate) -
In Situ Fill and Cap Alternative, 1995 to 2040 ¹**

Year	Construction/Operations/ D&D	Post Remediation	Routine Operations Adjustment ²	Total
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	146	0	0	146
2001	146	0	0	146
2002	141	0	0	141
2003	139	0	0	139
2004	136	0	0	136
2005	134	0	0	134
2006	136	0	0	136
2007	144	0	0	144
2008	109	0	0	109
2009	109	0	0	109
2010	106	21	0	127
2011	104	31	0	135
2012	101	31	0	132
2013	98	32	0	130
2014	98	21	0	119
2015	106	32	0	138
2016	106	43	0	149
2017	101	43	0	144
2018	93	32	0	125
2019	96	32	0	128
2020	98	6	0	104
2021	76	6	0	82
2022	0	6	0	13
2023	0	6	-166	-160
2024	0	6	26	32
2025	0	6	-77	-71
2026	0	6	-79	-73
2027	0	6	-81	-75
2028	0	6	-81	-75
2029	0	6	-50	-44
2030	0	6	-10	-4
2031	0	6	0	6
2032	0	6	0	6
2033	0	6	0	6
2034	0	6	0	6
2035	0	6	0	6
2036	0	6	0	6
2037	0	6	0	6
2038	0	6	0	6
2039	0	6	0	6
2040	0	6	0	6

Notes:

¹ Hanford Site Baseline employment is shown on Table H.3.2.1.

² Routine operations are those in addition to routine operations labor requirements under the TWRS program Tri-Party Agreement estimate, which includes approximately 1,000 employees for routine operations through 2005 and a phaseout of employment through 2029. The employment estimate assumes employment for routine operations would continue at 1995 levels through 2040.

**Table H.3.1.4 Full-Time Equivalent Employees by Phase (Change from Baseline Estimate) -
In Situ Vitrification Alternative, 1995 to 2040**

Year	Construction	Operations	Monitoring and Maintenance	Closure	Routine Operations (Difference from Baseline)	Total
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	572	20	0	0	0	592
1999	1,144	39	0	0	0	1,183
2000	1,716	542	0	0	0	2,258
2001	1,936	562	0	0	0	2,498
2002	1,936	562	0	0	0	2,498
2003	1,716	542	0	0	0	2,258
2004	2,068	542	0	0	0	2,610
2005	1,760	483	0	0	0	2,243
2006	1,760	483	0	0	0	2,243
2007	1,760	564	0	0	0	2,324
2008	1,232	483	0	0	0	1,715
2009	704	483	0	0	0	1,187
2010	528	483	0	21	0	1,032
2011	528	483	0	31	0	1,042
2012	528	483	0	31	0	1,042
2013	528	483	0	32	0	1,043
2014	528	403	0	21	0	952
2015	528	403	0	32	0	963
2016	528	403	0	43	0	974
2017	0	0	0	43	52	95
2018	0	0	0	32	-167	-135
2019	0	0	0	32	-362	-330
2020	0	0	6	0	-588	-582
2021	0	0	6	0	-563	-557
2022	0	0	6	0	-556	-550
2023	0	0	6	0	-541	-535
2024	0	0	6	0	-162	-156
2025	0	0	6	0	-77	-71
2026	0	0	6	0	-79	-73
2027	0	0	6	0	-81	-75
2028	0	0	6	0	-81	-75
2029	0	0	6	0	-50	-44
2030	0	0	6	0	-10	-4
2031	0	0	6	0	0	6
2032	0	0	6	0	0	6
2033	0	0	6	0	0	6
2034	0	0	6	0	0	6
2035	0	0	6	0	0	6
2036	0	0	6	0	0	6
2037	0	0	6	0	0	6
2038	0	0	6	0	0	6
2039	0	0	6	0	0	6
2040	0	0	6	0	0	6

Notes:

¹ Negative numbers result from phaseout of routine operations on an earlier schedule than included in the TWRS program Tri-Party Agreement estimate.

Table H.3.1.5 Full-Time Equivalent Employees by Phase (Change from Baseline Estimate) - Ex Situ Intermediate Separations Alternative, 1995 to 2040

Year	Waste Retrieval and Transfer Phase		Decontamination and Decommissioning	Operations Phase		Decontamination and Decommissioning	Monitoring and Maintenance	Closure	Total
	Construction	Operations		Construction	Operations				
1995	0	0	0	0	0	0	0	0	0
1996	0	0	0	844	0	0	0	0	844
1997	0	0	0	1,488	0	0	0	0	1,488
1998	378	0	0	2,082	153	0	0	0	2,613
1999	604	0	0	2,082	153	0	0	0	2,839
2000	680	0	0	2,970	153	0	0	0	3,803
2001	756	325	0	2,674	305	0	0	0	4,060
2002	832	650	0	2,276	305	0	0	0	4,063
2003	756	650	0	1,878	610	0	0	0	3,894
2004	756	650	0	1,728	610	0	0	0	3,744
2005	756	650	0	790	763	0	0	0	2,959
2006	606	650	0	494	763	0	0	0	2,513
2007	576	650	0	346	610	0	0	0	2,182
2008	546	650	0	198	610	0	0	0	2,004
2009	516	2,275	0	50	610	0	0	0	3,451
2010	516	2,600	0	0	610	0	0	3	3,729
2011	516	2,600	0	0	610	0	0	4	3,730
2012	516	2,600	245	0	610	0	0	10	3,981
2013	410	2,600	343	0	610	0	0	11	3,974
2014	334	2,600	343	0	610	0	0	17	3,904
2015	258	2,600	343	0	610	0	0	20	3,831
2016	182	2,600	343	0	610	0	0	20	3,755
2017	106	2,600	343	0	610	0	0	20	3,679
2018	0	2,275	343	0	915	0	0	20	3,553
2019	0	650	343	0	763	82	0	20	1,858
2020	0	325	343	0	763	163	0	20	1,614
2021	0	325	343	0	610	245	0	19	1,542
2022	0	325	343	0	610	266	0	19	1,563
2023	0	325	343	0	305	266	9	18	1,266
2024	0	325	343	0	153	266	9	16	1,112
2025	0	0	294	0	153	266	9	16	738
2026	0	0	245	0	153	245	9	16	668

Table H.3.1.5 Full-Time Equivalent Employees by Phase (Change from Baseline Estimate) - Ex Situ Intermediate Separations Alternative, 1995 to 2040 (cont'd)

Year	Waste Retrieval and Transfer Phase		Decontamination and Decommissioning	Operations Phase		Decontamination and Decommissioning	Monitoring and Maintenance	Closure	Total
	Construction	Operations		Construction	Operations				
2027	0	0	0	0	153	163	9	15	340
2028	0	0	0	0	0	82	9	27	118
2029	0	0	0	0	0	0	9	34	43
2030	0	0	0	0	0	0	9	63	72
2031	0	0	0	0	0	0	9	92	101
2032	0	0	0	0	0	0	8	63	71
2033	0	0	0	0	0	0	8	34	42
2034	0	0	0	0	0	0	8	20	28
2035	0	0	0	0	31	0	8	6	45
2036	0	0	0	0	31	0	8	6	45
2037	0	0	0	0	31	0	8	6	45
2038	0	0	0	0	31	0	8	6	45
2039	0	0	0	0	31	0	8	6	45
2040	0	0	0	0	31	0	8	6	45

**Table H.3.1.6 Full-Time Equivalent Employees by Phase (Change from Baseline Estimate) -
Ex Situ No Separations Alternative, 1995 to 2040**

Year	Construction	Operation	Post Remediation	Total
1995	0	0	0	0
1996	0	0	0	0
1997	1,481	0	0	1,481
1998	2,595	0	0	2,595
1999	4,292	0	0	4,292
2000	4,371	98	0	4,469
2001	2,968	1,141	0	4,109
2002	2,306	1,553	0	3,859
2003	746	1,966	0	2,712
2004	746	2,379	0	3,125
2005	746	2,694	0	3,440
2006	609	2,694	0	3,303
2007	581	2,694	0	3,275
2008	554	2,694	0	3,248
2009	526	2,379	0	2,905
2010	526	2,379	6	2,911
2011	526	2,379	7	2,912
2012	526	2,379	14	2,919
2013	420	2,379	15	2,814
2014	342	2,379	15	2,736
2015	263	2,379	15	2,657
2016	185	2,064	21	2,270
2017	106	1,749	21	1,876
2018	0	1,434	23	1,457
2019	0	0	512	512
2020	0	0	414	414
2021	0	0	315	315
2022	0	0	217	217
2023	0	0	118	118
2024	0	0	16	16
2025	0	0	10	10
2026	0	0	10	10
2027	0	0	10	10
2028	0	0	18	18
2029	0	0	29	29
2030	0	0	49	49
2031	0	0	70	70
2032	0	0	43	43
2033	0	0	21	21
2034	0	0	11	11
2035	0	0	9	9
2036	0	0	9	9
2037	0	0	9	9
2038	0	0	9	9
2039	0	0	9	9
2040	0	0	9	9

**Table H.3.1.7 Full-Time Equivalent Employees by Phase (Change from Baseline Estimate) -
Ex Situ Extensive Separations Alternative, 1995 to 2040**

Year	Construction	Operations	Post Remediation	Total
1995	0	0	0	0
1996	700	0	0	700
1997	2,288	0	0	2,288
1998	3,366	0	0	3,366
1999	2,380	14	0	2,394
2000	1,432	28	0	1,460
2001	2,448	367	0	2,815
2002	4,404	706	0	5,110
2003	5,644	1,345	0	6,989
2004	4,516	900	0	5,416
2005	3,012	914	0	3,926
2006	1,734	942	0	2,676
2007	576	942	0	1,518
2008	546	942	0	1,488
2009	516	2,567	0	3,083
2010	516	2,892	3	3,411
2011	516	2,892	4	3,412
2012	516	2,892	255	3,663
2013	410	2,892	354	3,656
2014	334	2,892	360	3,586
2015	258	2,892	363	3,513
2016	182	2,892	363	3,437
2017	106	2,892	363	3,361
2018	0	2,567	363	2,930
2019	0	1,039	363	1,402
2020	0	825	363	1,188
2021	0	686	362	1,048
2022	0	659	362	1,021
2023	0	450	370	820
2024	0	422	368	790
2025	0	0	319	319
2026	0	0	270	270
2027	0	0	24	24
2028	0	0	36	36
2029	0	0	43	43
2030	0	0	72	72
2031	0	0	101	101
2032	0	0	71	71
2033	0	0	42	42
2034	0	0	28	28
2035	0	0	14	14
2036	0	0	14	14
2037	0	0	14	14
2038	0	0	14	14
2039	0	0	14	14
2040	0	0	14	14

**Table H.3.1.8 Full-Time Equivalent Employees by Phase (Change from Baseline Estimate) -
Ex Situ/In Situ Combination Alternative, 1995 to 2040**

Year	Construction	Operation	Post Remediation	Routine Operations (Difference from Baseline) ¹	Total
1995	0	0	0	0	0
1996	515	0	0	0	515
1997	908	0	0	0	908
1998	1,501	89	0	0	1,589
1999	1,638	89	0	0	1,727
2000	2,227	89	0	0	2,315
2001	2,092	365	0	0	2,458
2002	1,896	554	0	0	2,450
2003	1,607	731	0	0	2,338
2004	1,515	731	0	0	2,246
2005	943	820	0	0	1,763
2006	671	820	0	0	1,491
2007	562	731	0	0	1,293
2008	454	731	0	0	1,185
2009	345	1,673	0	0	2,019
2010	315	1,862	15	0	2,191
2011	315	1,862	21	0	2,198
2012	315	1,862	174	0	2,351
2013	250	1,862	235	0	2,347
2014	204	1,862	232	0	2,298
2015	157	1,862	241	0	2,260
2016	111	1,862	247	0	2,220
2017	65	1,862	247	0	2,174
2018	0	1,850	241	0	2,091
2019	0	820	291	0	1,110
2020	0	631	320	0	952
2021	0	542	370	0	912
2022	0	542	383	4	929
2023	0	365	391	-100	657
2024	0	277	390	16	683
2025	0	89	360	-46	403
2026	0	89	317	-47	359
2027	0	89	117	-49	157
2028	0	0	75	-49	26
2029	0	0	29	-30	-1
2030	0	0	46	-6	40
2031	0	0	63	0	63
2032	0	0	45	0	45
2033	0	0	28	0	28
2034	0	0	20	0	20
2035	0	18	12	0	30
2036	0	18	12	0	30
2037	0	18	12	0	30
2038	0	18	12	0	30
2039	0	18	12	0	30
2040	0	18	12	0	30

Note:

¹ Negative numbers result from phaseout of the routine operations on an earlier schedule than included in the TWRS program Tri-Party Agreement estimate.

**Table H.3.1.9 Full-Time Equivalent Employees by Element (Change from Baseline Estimate) -
Phased Implementation Alternative (Phase 1), 1995 to 2013**

Year	Construction	Operations	Post Remediation	Total
1995	0	0	0	0
1996	89	0	0	89
1997	770	0	0	770
1998	2,304	0	0	2,304
1999	3,263	0	0	3,263
2000	2,093	0	0	3,093
2001	1,353	0	0	1,353
2002	0	544	0	544
2003	0	544	0	544
2004	0	544	0	544
2005	0	544	0	544
2006	0	586	0	586
2007	0	586	0	586
2008	0	586	0	586
2009	0	586	0	586
2010	0	586	0	586
2011	0	586	0	586
2012	0	0	961	961
2013	0	0	961	961

Note:

Phase 1 of the Phased Implementation alternative would conclude in 2013.

**Table H.3.1.10 Full-Time Equivalent Employees by Element (Change from Baseline Estimate) -
Phased Implementation Alternative (Total Alternative), 1995 to 2040**

Year	Construction	Operations	Post Remediation	Routine Operations (Difference from Baseline) ¹	Total
1995	0	0	0	0	0
1996	89	0	0	0	89
1997	770	0	0	0	770
1998	2,304	0	0	0	2,304
1999	3,263	0	0	0	3,263
2000	3,093	0	0	0	3,093
2001	1,353	0	0	0	1,353
2002	0	536	0	0	536
2003	0	536	0	0	536
2004	337	536	0	0	873
2005	1,100	536	0	0	1,636
2006	1,729	578	0	0	2,307
2007	2,545	850	0	0	3,395
2008	2,613	1,122	0	0	3,735
2009	2,545	1,649	0	0	4,194
2010	2,545	2,185	0	0	4,730
2011	1,797	2,629	0	0	4,426
2012	541	2,806	0	0	3,347
2013	514	3,041	0	0	3,555
2014	487	3,041	0	0	3,528
2015	461	2,774	247	0	3,482
2016	461	2,774	356	0	3,591
2017	461	2,774	356	0	3,591
2018	461	2,774	356	0	3,591
2019	366	2,774	356	0	3,496
2020	298	2,774	356	0	3,428
2021	0	2,774	356	0	3,130
2022	0	2,774	809	0	3,583
2023	0	2,506	878	0	3,384
2024	0	1,425	564	0	1,989
2025	0	980	582	0	1,562
2026	0	0	549	-79	470
2027	0	0	508	-81	427
2028	0	0	261	-81	180
2029	0	0	243	-50	193
2030	0	0	174	-10	164
2031	0	0	34	0	34
2032	0	0	34	0	34
2033	0	0	34	0	34
2034	0	0	34	0	34
2035	0	0	24	0	24
2036	0	0	24	0	24
2037	0	0	24	0	24
2038	0	0	24	0	24
2039	0	0	24	0	24
2040	0	0	5	0	5

Notes:

¹ Negative numbers result from phaseout of routine operations on an earlier schedule than included in the TWRS program Tri-Party Agreement estimate.

Table H.3.2.1 Hanford Site Employment with the No Action, Long-Term Management, and In Situ Fill and Cap Alternatives (Change from Baseline Estimate), 1994 to 2040 (Full-Time Equivalent Employees)

Year	Baseline	No Action	Long-Term Management	In Situ Fill and Cap	Percentage Change from Baseline		
					No Action	Long-Term Management	In Situ Fill and Cap
1994	18,436	18,436	18,436	18,436	0.00	0.00	0.00
1995	17,406	17,406	17,406	17,406	0.00	0.00	0.00
1996	15,401	15,401	15,401	15,401	0.00	0.00	0.00
1997	14,939	14,939	14,939	14,939	0.00	0.00	0.00
1998	14,883	14,883	14,883	14,883	0.00	0.00	0.00
1999	14,758	14,758	14,758	14,770	0.00	0.00	0.08
2000	14,580	14,580	14,580	14,713	0.00	0.00	0.92
2001	14,366	14,366	14,366	14,511	0.00	0.00	1.01
2002	13,976	13,976	13,976	14,117	0.00	0.00	1.01
2003	13,527	13,527	13,527	13,666	0.00	0.00	1.03
2004	13,120	13,120	13,120	13,256	0.00	0.00	1.04
2005	12,795	12,800	12,800	12,929	0.04	0.02	1.05
2006	12,416	12,474	12,474	12,553	0.46	0.19	1.10
2007	11,889	11,979	11,979	12,029	0.76	0.24	1.18
2008	11,335	11,517	11,517	11,447	1.60	0.52	0.99
2009	10,779	10,976	10,976	10,889	1.83	0.47	1.03
2010	10,182	10,393	10,393	10,308	2.08	0.50	1.24
2011	9,559	9,784	9,784	9,693	2.36	0.53	1.40
2012	9,042	9,294	9,294	9,174	2.79	0.60	1.46
2013	8,704	8,966	8,966	8,833	3.02	0.61	1.48
2014	8,403	8,674	8,674	8,525	3.22	0.62	1.45
2015	8,122	8,423	8,423	8,259	3.70	0.71	1.69
2016	7,985	8,293	8,293	8,133	3.85	0.69	1.85
2017	8,041	8,393	8,393	8,184	4.38	0.82	1.78
2018	8,131	8,507	8,507	8,258	4.62	0.83	1.56
2019	8,229	8,642	8,642	8,355	5.02	0.92	1.53
2020	8,344	8,773	8,773	8,449	5.14	0.92	1.25
2021	8,497	8,949	8,949	8,575	5.31	0.96	0.92
2022	8,577	9,038	9,038	8,582	5.37	0.95	0.05
2023	8,518	9,023	9,023	8,388	5.93	1.07	-1.52
2024	8,454	9,283	9,283	8,461	9.81	2.00	0.09
2025	8,430	9,361	9,361	8,367	11.05	1.95	-0.74
2026	8,416	9,353	9,353	8,343	11.13	1.85	-0.87
2027	8,369	9,304	9,304	8,294	11.17	1.82	-0.89
2028	8,277	9,215	9,215	8,205	11.33	1.82	-0.88
2029	8,143	9,109	9,109	8,099	11.87	1.88	-0.53
2030	7,983	8,987	8,996	7,977	12.57	1.98	-0.08
2031	7,781	8,796	8,903	7,786	13.05	2.23	0.07
2032	7,551	8,567	8,730	7,557	13.45	2.28	0.08
2033	7,314	8,330	8,652	7,320	13.89	2.66	0.08
2034	7,081	8,097	8,435	7,087	14.35	2.54	0.08
2035	6,849	7,865	8,203	6,855	14.83	2.51	0.09
2036	6,612	7,628	7,966	6,618	15.37	2.50	0.09
2037	6,371	7,387	7,697	6,377	15.95	2.41	0.09
2038	6,130	7,146	7,174	6,136	16.57	1.65	0.10
2039	5,891	6,907	6,907	5,897	17.25	1.82	0.10
2040	5,652	6,668	6,668	5,658	17.98	1.84	0.11

Notes:

Negative numbers result from phaseout of routine operations on an earlier schedule than included in the TWRS program Tri-Party Agreement estimate.

Table H.3.2.2 Hanford Site Employment with the In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives (Change from Baseline Estimate), 1994 to 2040 (Full-Time Equivalent Employees)

Year	Baseline	In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations	Percentage Change from Baseline		
					In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations
1994	18,436	18,436	18,436	18,436	0.00	0.00	0.00
1995	17,406	17,406	17,476	17,406	0.00	0.40	0.00
1996	15,401	15,401	16,228	15,524	0.00	5.37	0.80
1997	14,939	14,989	16,468	16,390	0.33	10.23	9.71
1998	14,883	15,474	17,421	17,526	3.98	17.05	17.76
1999	14,758	15,981	17,658	18,923	8.29	19.65	28.22
2000	14,580	16,768	18,324	19,004	15.01	25.68	30.35
2001	14,366	16,844	18,405	18,484	17.25	28.11	28.67
2002	13,976	16,454	18,025	17,760	17.73	28.97	27.08
2003	13,527	15,835	17,423	16,369	17.06	28.80	21.01
2004	13,120	15,670	16,811	16,236	19.44	28.13	23.76
2005	12,795	15,068	15,782	16,197	17.77	23.35	26.59
2006	12,416	14,666	14,939	15,728	18.12	20.32	26.68
2007	11,889	14,156	14,084	15,164	19.06	18.46	27.55
2008	11,335	13,057	13,475	14,557	15.19	18.87	28.42
2009	10,779	11,997	14,132	13,713	11.30	31.11	27.22
2010	10,182	11,227	13,888	13,092	10.27	36.40	28.59
2011	9,559	10,600	13,310	12,471	10.89	39.24	30.47
2012	9,042	10,084	13,001	11,951	11.53	43.79	32.18
2013	8,704	9,739	12,672	11,520	11.90	45.60	32.36
2014	8,403	9,364	12,307	11,139	11.43	46.46	32.56
2015	8,122	9,085	11,953	10,753	11.86	47.17	32.40
2016	7,985	8,885	11,740	10,255	11.27	47.02	28.42
2017	8,041	8,190	11,716	9,915	1.85	45.70	23.31
2018	8,131	7,999	11,554	9,545	-1.62	42.09	17.38
2019	8,229	7,894	10,208	8,812	-4.07	24.05	7.08
2020	8,344	7,785	9,973	8,758	-6.70	19.51	4.96
2021	8,497	7,939	10,047	8,812	-6.57	18.24	3.71
2022	8,577	8,028	10,114	8,794	-6.40	17.91	2.53
2023	8,518	8,013	9,796	8,635	-5.92	15.00	1.38
2024	8,454	8,273	9,547	8,478	-2.14	12.94	0.28
2025	8,430	8,351	9,193	8,434	-0.93	9.06	0.05
2026	8,416	8,343	9,062	8,353	-0.87	7.68	-0.74
2027	8,369	8,294	8,718	8,299	0.89	4.17	-0.84
2028	8,277	8,205	8,407	8,217	-0.88	1.57	-0.73
2029	8,143	8,099	8,194	8,123	-0.53	0.63	-0.24
2030	7,983	7,977	8,055	8,020	-0.08	0.90	0.46
2031	7,781	7,786	7,877	7,846	0.07	1.24	0.84
2032	7,551	7,557	7,622	7,595	0.08	0.94	0.57
2033	7,314	7,320	7,357	7,336	0.08	0.59	0.30
2034	7,081	7,087	7,111	7,092	0.08	0.43	0.17
2035	6,849	6,855	6,892	6,858	0.09	0.64	0.13
2036	6,612	6,618	6,657	6,621	0.09	0.68	0.14
2037	6,371	6,377	6,416	6,380	0.09	0.71	0.14
2038	6,130	6,136	6,175	6,139	0.10	0.73	0.15
2039	5,891	5,897	5,936	5,900	0.10	0.76	0.15
2040	5,652	5,658	5,697	5,661	0.11	0.80	0.16

Table H.3.2.3 Hanford Site Employment with the Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives (Change from Baseline Estimate), 1994 to 2040 (Full-Time Equivalent Employees)

Year	Baseline	Ex Situ Extensive Separations	Ex Situ/ In Situ Combination	Phased Implementation		Percentage Change from Baseline			
				Phase I	Total	Ex Situ Extensive Separation	Ex Situ/ In Situ Combination	Phased Implementation	
								Phase I	Total
1994	18,436	18,436	18,436	18,436	18,436	0.00	0.00	0.00	0.00
1995	17,406	17,464	17,449	17,413	17,413	0.33	0.25	0.04	0.04
1996	15,401	16,175	15,906	15,539	15,539	5.03	3.28	0.90	0.90
1997	14,939	17,185	15,871	15,781	15,781	15.03	6.24	5.63	5.63
1998	14,883	18,078	16,427	17,139	17,139	21.47	10.37	15.16	15.16
1999	14,758	17,155	16,522	17,927	17,927	16.24	11.96	21.47	21.47
2000	14,580	16,230	16,858	17,542	17,542	11.32	15.63	20.32	20.32
2001	14,366	17,259	16,811	15,796	15,796	20.14	17.02	9.96	9.95
2002	13,976	19,052	16,417	14,588	14,580	36.31	17.47	4.37	4.32
2003	13,527	20,229	15,867	14,071	14,091	49.54	17.29	4.02	4.17
2004	13,120	18,543	15,333	13,664	14,028	41.33	16.87	4.15	6.92
2005	12,795	16,741	14,575	13,342	14,423	30.84	13.91	4.28	12.73
2006	12,416	15,100	13,913	12,999	14,758	21.61	12.06	4.69	18.86
2007	11,889	13,501	13,190	12,475	15,222	13.56	10.94	4.93	28.03
2008	11,335	12,959	12,599	11,921	15,080	14.32	11.14	5.17	33.04
2009	10,779	13,756	12,742	11,365	14,979	27.62	18.22	5.44	38.97
2010	10,182	13,565	12,359	10,768	14,842	33.23	21.38	5.76	45.77
2011	9,559	12,971	11,769	10,176	13,920	35.70	23.12	6.46	45.63
2012	9,042	12,450	11,379	9,971	12,496	37.70	25.85	10.28	38.20
2013	8,704	12,020	11,047	9,585	12,239	38.10	26.92	10.12	40.62
2014	8,403	11,646	10,702	8,483	11,930	38.59	27.35	0.95	41.96
2015	8,122	11,292	10,382	8,122	11,617	39.03	27.82	0.00	43.03
2016	7,985	11,079	10,205	7,985	11,567	38.75	27.79	0.00	44.86
2017	8,041	11,029	10,211	8,041	11,632	37.17	27.00	0.00	44.66
2018	8,131	10,634	10,147	8,131	11,715	30.77	24.79	0.00	44.06
2019	8,229	9,479	9,408	8,229	11,727	15.20	14.32	0.00	42.31
2020	8,344	9,359	9,306	8,344	11,753	12.15	11.52	0.00	40.85
2021	8,497	9,452	9,414	8,497	11,690	11.23	10.79	0.00	39.57
2022	8,577	9,505	9,482	8,577	12,106	10.82	10.55	0.00	41.14
2023	8,518	9,275	9,199	8,518	11,802	8.89	8.00	0.00	38.56
2024	8,454	9,134	9,111	8,454	10,523	8.05	7.78	0.00	24.48
2025	8,430	8,754	8,852	8,430	9,936	3.85	5.01	0.00	17.87
2026	8,416	8,681	8,761	8,416	8,973	3.15	4.11	0.00	6.62
2027	8,369	8,557	8,532	8,369	8,779	2.25	1.95	0.00	4.90
2028	8,277	8,395	8,312	8,277	8,479	1.42	0.42	0.00	2.44
2029	8,143	8,194	8,147	8,143	8,332	0.63	0.06	0.00	2.33
2030	7,983	8,055	8,022	7,983	8,139	0.90	0.48	0.00	1.95
2031	7,781	7,877	7,841	7,781	7,826	1.24	0.77	0.00	0.58
2032	7,551	7,622	7,596	7,551	7,585	0.94	0.60	0.00	0.45
2033	7,314	7,357	7,343	7,314	7,348	0.59	0.39	0.00	0.46
2034	7,081	7,109	7,102	7,081	7,114	0.40	0.30	0.00	0.47
2035	6,849	6,864	6,877	6,849	6,874	0.22	0.42	0.00	0.36
2036	6,612	6,626	6,641	6,612	6,636	0.21	0.45	0.00	0.36
2037	6,371	6,385	6,400	6,371	6,395	0.22	0.46	0.00	0.38
2038	6,130	6,144	6,160	6,130	6,154	0.23	0.48	0.00	0.39
2039	5,891	5,905	5,920	5,891	5,913	0.24	0.50	0.00	0.38
2040	5,652	5,666	5,681	5,652	5,657	0.25	0.52	0.00	0.09

Table H.3.2.4 Tri-Cities MSA Nonfarm Employment with the No Action, Long-Term Management, and In Situ Fill and Cap Alternatives (Change from Baseline Estimate), 1994 to 2040

Year	Baseline	No Action	Long-Term Management	In Situ Fill and Cap	Percentage Change from Baseline		
					No Action	Long-Term Management	In Situ Fill and Cap
1994	73,604	73,604	73,604	73,604	0.00	0.00	0.00
1995	69,885	69,885	69,885	69,885	0.00	0.00	0.00
1996	66,683	66,683	66,683	66,683	0.00	0.00	0.00
1997	68,046	68,046	68,046	68,046	0.00	0.00	0.00
1998	69,126	69,126	69,126	69,126	0.00	0.00	0.00
1999	69,707	69,707	69,707	69,737	0.00	0.00	0.04
200	70,215	70,215	70,215	70,531	0.00	0.00	0.45
2001	70,679	70,679	70,679	70,924	0.00	0.00	0.35
2002	70,744	70,744	70,744	70,969	0.00	0.00	0.32
2003	70,809	70,809	70,809	71,032	0.00	0.00	0.31
2004	71,023	71,023	71,023	71,240	0.00	0.00	0.31
2005	71,405	71,417	71,417	71,620	0.02	0.02	0.30
2006	71,589	71,725	71,725	71,811	0.19	0.19	0.31
2007	71,453	71,625	71,625	71,683	0.24	0.24	0.32
2008	71,376	71,745	71,745	71,533	0.52	0.52	0.22
2009	71,313	71,646	71,646	71,490	0.47	0.47	0.25
2010	71,154	71,508	71,508	71,371	0.50	0.50	0.31
2011	70,965	71,341	71,341	71,188	0.53	0.53	0.31
2012	71,055	71,485	71,485	71,267	0.60	0.60	0.30
2013	71,496	71,929	71,929	71,702	0.61	0.61	0.29
2014	71,880	72,324	72,324	72,070	0.62	0.62	0.26
2015	72,281	72,792	72,792	72,515	0.71	0.71	0.32
2016	73,018	73,520	73,520	73,265	0.69	0.69	0.34
2017	74,104	74,711	74,711	74,331	0.82	0.82	0.31
2018	75,119	75,746	75,746	75,311	0.83	0.83	0.26
2019	76,122	76,821	76,821	76,324	0.92	0.92	0.27
2020	77,162	77,868	77,868	77,313	0.92	0.92	0.20
2021	78,279	79,028	79,028	78,384	0.96	0.96	0.13
2022	79,188	79,940	79,940	79,134	0.95	0.95	-0.07
2023	79,816	80,669	80,669	79,496	1.07	1.07	-0.40
2024	80,547	82,155	82,155	80,672	2.00	2.00	0.15
2025	81,381	82,971	82,971	81,222	1.95	1.95	-0.20
2026	82,206	83,725	83,725	82,079	1.85	1.85	-0.15
2027	82,942	84,452	84,452	82,820	1.82	1.82	-0.15
2028	83,596	85,113	85,113	83,481	1.82	1.82	-0.14
2029	84,183	85,769	85,769	84,137	1.88	1.88	-0.05
2030	84,744	86,396	86,419	84,764	1.95	1.98	0.02
2031	85,221	86,871	87,123	85,239	1.94	2.23	0.02
2032	85,666	87,309	87,618	85,677	1.92	2.28	0.01
2033	86,115	87,757	88,410	86,125	1.91	2.66	0.01
2034	86,582	88,224	88,783	86,591	1.90	2.54	0.01
2035	87,046	88,688	89,235	87,056	1.89	2.51	0.01
2036	87,499	89,141	89,687	87,509	1.88	2.50	0.01
2037	87,945	89,587	90,064	87,954	1.87	2.41	0.01
2038	88,396	90,038	89,852	88,405	1.86	1.65	0.01
2039	88,849	90,491	90,468	88,859	1.85	1.82	0.01
2040	89,301	90,944	90,944	89,311	1.84	1.84	0.01

Table H.3.2.5 Tri-Cities MSA Nonfarm Employment with the In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives (Change from Baseline Estimate), 1994 to 2040

Year	Baseline	In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations	Percentage Change from Baseline		
					In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations
1994	73,604	73,604	73,604	73,604	0.00	0.00	0.00
1995	69,885	69,885	70,057	69,885	0.00	0.25	0.00
1996	66,683	66,683	68,643	66,984	0.00	2.94	0.45
1997	68,046	68,166	71,092	71,482	0.18	4.48	5.05
1998	69,126	70,529	74,059	74,380	2.03	7.14	7.60
1999	69,707	72,204	74,693	77,691	3.58	7.15	11.45
2000	70,215	74,545	76,960	77,578	6.17	9.61	10.49
2001	70,679	74,922	77,449	77,083	6.00	9.58	9.06
2002	70,744	74,749	77,295	76,585	5.66	9.26	8.26
2003	70,809	74,398	76,979	74,627	5.07	8.71	5.39
2004	71,023	75,344	76,820	76,286	6.08	8.16	7.41
2005	71,405	74,852	75,654	77,138	4.83	5.95	8.03
2006	71,589	75,205	75,283	76,867	5.05	5.16	7.37
2007	71,453	75,130	74,731	76,716	5.15	4.59	7.37
2008	71,376	73,710	74,788	76,539	3.27	4.78	7.23
2009	71,313	72,867	77,732	75,818	2.18	9.00	6.32
2010	71,154	72,702	77,433	75,839	2.18	8.82	6.58
2011	70,965	72,644	77,064	75,674	2.37	8.59	6.64
2012	71,055	72,740	77,626	75,755	2.37	9.25	6.61
2013	71,496	73,163	77,917	75,970	2.33	8.98	6.26
2014	71,880	73,371	78,136	76,236	2.07	8.70	6.06
2015	72,281	73,839	78,412	76,447	2.16	8.48	5.76
2016	73,018	74,420	79,024	76,388	1.92	8.23	4.62
2017	74,104	73,728	79,978	76,808	-0.51	7.93	3.65
2018	75,119	74,675	80,443	77,024	-0.59	7.09	2.54
2019	76,122	75,414	78,133	76,380	-0.93	2.64	0.34
2020	77,162	76,074	79,505	77,692	-1.41	3.04	0.69
2021	78,279	77,377	80,719	78,707	-1.15	3.12	0.55
2022	79,188	78,307	81,660	79,457	-1.11	3.12	0.34
2023	79,816	79,037	81,668	79,924	-0.98	2.32	0.14
2024	80,547	80,522	82,163	80,509	-0.03	2.01	-0.05
2025	81,381	81,339	82,343	81,371	-0.05	1.18	-0.01
2026	82,206	82,092	83,155	82,050	-0.14	1.15	-0.19
2027	82,942	82,820	83,261	82,823	-0.15	0.38	-0.14
2028	83,596	83,481	83,627	83,507	-0.14	0.04	-0.11
2029	84,183	84,137	84,202	84,185	-0.05	0.02	0.00
2030	84,744	84,764	84,877	84,849	0.02	0.16	0.12
2031	85,221	85,239	85,396	85,350	0.02	0.21	0.15
2032	85,666	85,677	85,761	85,718	0.01	0.11	0.06
2033	86,115	86,125	86,162	86,133	0.01	0.05	0.02
2034	86,582	86,591	86,621	86,592	0.01	0.05	0.01
2035	87,046	87,056	87,128	87,059	0.01	0.09	0.01
2036	87,499	87,509	87,573	87,513	0.01	0.08	0.02
2037	87,945	87,954	88,017	87,959	0.01	0.08	0.02
2038	99,396	88,405	88,468	88,410	0.01	0.08	0.02
2039	88,849	88,859	88,922	88,864	0.01	0.08	0.02
2040	89,301	89,311	89,374	89,316	0.01	0.08	0.02

Table H.3.2.6 Tri-Cities MSA Nonfarm Employment with the Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives (Change from Baseline Estimate), 1994 to 2040

Year	Baseline	Ex Situ Extensive Separations	Ex Situ/ In Situ Combination	Phased Implementation		Percentage Change from Baseline			
				Phase 1	Total	Ex Situ Extensive Separations	Ex Situ/ In Situ Combination	Phased Implementation	
								Phase 1	Total
1994	73,604	73,604	73,604	73,604	73,604.00	0.00	0.00	0.00	0.00
1995	69,885	70,027	69,990	69,903	69,903	0.20	0.15	0.03	0.03
1996	66,683	68,523	67,879	67,014	67,014	2.76	1.79	0.50	0.50
1997	68,046	72,885	69,903	69,983	69,983	7.11	2.73	2.85	2.85
1998	69,126	75,071	72,125	73,936	73,936	8.60	4.34	6.96	6.96
1999	69,707	72,925	72,741	75,579	75,580	4.62	4.35	8.42	8.42
2000	70,215	72,268	74,319	74,832	74,832	2.92	5.85	6.58	6.58
2001	70,679	76,377	74,768	71,731	71,729	8.06	5.79	1.49	1.49
2002	70,744	80,742	74,686	71,058	71,041	14.13	5.57	0.44	0.42
2003	70,809	82,977	74,506	71,633	71,688	17.18	5.22	1.16	1.24
2004	71,023	78,736	74,497	71,902	72,775	10.86	4.89	1.24	2.47
2005	71,405	76,567	73,926	72,292	74,629	7.23	3.53	1.24	4.51
2006	71,589	74,887	73,774	72,559	75,960	4.61	3.05	1.36	6.11
2007	71,453	73,177	73,394	72,403	77,655	2.41	2.72	1.33	8.68
2008	71,376	74,009	73,387	72,323	77,767	3.69	2.82	1.33	8.95
2009	71,313	77,239	75,062	72,260	78,476	8.31	5.26	1.33	10.05
2010	71,154	76,957	74,849	72,101	79,063	8.16	5.19	1.33	11.12
2011	70,965	76,504	74,564	71,989	77,768	7.80	5.07	1.44	9.59
2012	71,055	76,561	74,939	72,815	75,892	7.75	5.47	2.48	6.81
2013	71,496	76,778	75,287	72,879	77,276	7.39	5.30	1.94	8.08
2014	71,880	77,061	75,558	71,351	77,572	7.21	5.12	-0.74	7.92
2015	72,281	77,343	75,900	72,215	77,903	7.00	5.01	-0.09	7.78
2016	73,018	77,956	76,572	73,018	78,879	6.76	4.87	0.00	8.03
2017	74,104	78,847	77,572	74,104	79,916	6.40	4.68	0.00	7.84
2018	75,119	78,764	78,250	75,119	80,904	4.85	4.17	0.00	7.70
2019	76,122	77,113	77,338	76,122	81,706	1.30	1.60	0.00	7.34
2020	77,162	78,607	78,537	77,162	82,598	1.87	1.78	0.00	7.04
2021	78,279	79,772	79,725	78,279	83,261	1.91	1.85	0.00	6.36
2022	79,188	80,665	80,641	79,188	85,167	1.87	1.84	0.00	7.55
2023	79,816	80,899	80,734	79,816	84,923	1.36	1.15	0.00	6.40
2024	80,547	81,584	81,590	80,547	82,893	1.29	1.29	0.00	2.91
2025	81,381	81,613	81,870	81,381	83,353	0.28	0.60	0.00	2.42
2026	82,206	82,585	82,701	82,206	82,326	0.46	0.60	0.00	0.15
2027	82,942	83,183	83,056	82,942	83,484	0.29	0.14	0.00	0.65
2028	83,596	83,728	83,547	83,596	83,750	0.16	-0.06	0.00	0.18
2029	84,183	84,212	84,166	84,183	84,479	0.03	-0.02	0.00	0.35
2030	84,744	84,877	84,834	84,744	84,967	0.16	0.11	0.00	0.26
2031	85,221	85,396	85,335	85,221	85,202	0.21	0.13	0.00	-0.02
2032	85,666	85,761	85,727	85,666	85,712	0.11	0.07	0.00	0.05
2033	86,115	86,162	86,148	86,115	86,170	0.05	0.04	0.00	0.06
2034	86,582	86,614	86,610	86,582	86,634	0.04	0.03	0.00	0.06
2035	87,046	87,060	87,099	87,046	87,080	0.02	0.06	0.00	0.04
2036	87,499	87,521	87,547	87,499	87,537	0.03	0.06	0.00	0.04
2037	87,945	87,967	87,992	87,945	87,984	0.03	0.05	0.00	0.04
2038	88,396	88,418	88,443	88,396	88,435	0.03	0.05	0.00	0.04
2039	88,849	88,872	88,897	88,849	88,884	0.03	0.05	0.00	0.04
2040	89,301	89,324	89,349	89,301	89,295	0.03	0.05	0.00	-0.01

Table H.3.2.7 Tri-Cities MSA Population with the No Action, Long-Term Management, and In Situ Fill and Cap Alternatives (Change from Baseline Estimate), 1994 to 2040

Year	Baseline	No Action	Long-Term Management	In Situ Fill and Cap	Percentage Change from Baseline		
					No Action	Long-Term Management	In Situ Fill and Cap
1994	164,911	164,911	164,911	164,911	0.00	0.00	0.00
1995	171,358	171,358	171,358	171,358	0.00	0.00	0.00
1996	166,266	166,266	166,266	166,266	0.00	0.00	0.00
1997	161,933	161,933	161,933	161,932	0.00	0.00	0.00
1998	164,289	164,289	164,289	164,289	0.00	0.00	0.00
1999	166,230	166,230	166,230	166,230	0.00	0.00	0.00
2000	167,442	167,442	167,442	167,485	0.00	0.00	0.03
2001	168,544	168,544	168,544	169,008	0.00	0.00	0.28
2002	169,583	169,583	169,583	169,942	0.00	0.00	0.21
2003	170,037	170,037	170,037	170,367	0.00	0.00	0.19
2004	170,492	170,492	170,492	170,818	0.00	0.00	0.19
2005	171,164	171,164	171,164	171,483	0.00	0.02	0.19
2006	172,083	172,101	172,101	172,399	0.01	0.19	0.18
2007	172,711	172,911	172,911	173,037	0.12	0.24	0.19
2008	172,872	173,124	173,124	173,209	0.15	0.52	0.20
2009	173,117	173,658	173,658	173,348	0.31	0.47	0.13
2010	173,384	173,872	173,872	173,644	0.28	0.50	0.15
2011	173,510	174,028	174,028	173,828	0.30	0.53	0.18
2012	173,592	174,143	174,143	173,919	0.32	0.60	0.19
2013	174,083	174,713	174,713	174,393	0.36	0.61	0.18
2014	175,088	175,722	175,722	175,390	0.36	0.62	0.17
2015	176,010	176,660	176,660	176,288	0.37	0.71	0.16
2016	176,956	177,705	177,705	177,300	0.42	0.69	0.19
2017	178,395	179,131	179,131	178,758	0.41	0.82	0.20
2018	180,346	181,235	181,235	180,679	0.49	0.83	0.18
2019	182,193	183,112	183,112	182,474	0.50	0.92	0.15
2020	184,021	185,045	185,045	184,317	0.56	0.92	0.16
2021	185,904	186,939	186,939	186,125	0.56	0.96	0.12
2022	187,901	188,997	188,997	188,054	0.58	0.95	0.08
2023	189,590	190,693	190,693	189,512	0.58	1.07	-0.04
2024	190,870	192,121	192,121	190,402	0.66	2.00	-0.25
2025	192,301	194,657	194,657	192,484	1.22	1.95	0.10
2026	193,882	196,212	196,212	193,649	1.20	1.85	-0.12
2027	195,450	197,675	197,675	195,264	1.14	1.82	-0.09
2028	196,888	199,101	199,101	196,708	1.12	1.82	-0.09
2029	198,204	200,428	200,428	198,036	1.12	1.88	-0.08
2030	199,424	201,749	201,749	199,356	1.17	1.98	-0.03
2031	200,605	203,026	203,059	200,634	1.21	2.23	0.01
2032	201,662	204,081	204,451	201,689	1.20	2.28	0.01
2033	202,674	205,082	205,534	202,689	1.19	2.66	0.01
2034	203,691	206,098	207,959	203,705	1.18	2.54	0.01
2035	204,733	207,140	208,981	204,748	1.18	2.51	0.01
2036	205,774	208,180	208,981	205,788	1.17	2.50	0.01
2037	206,796	209,202	210,003	206,810	1.16	2.41	0.01
2038	207,808	210,215	210,914	207,822	1.16	1.65	0.01
2039	208,828	211,234	210,962	208,842	1.15	1.82	0.01
2040	209,851	212,258	212,224	209,865	1.15	1.84	0.01

Table H.3.2.8 Tri-Cities MSA Population with the In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives (Change from Baseline Estimate), 1994 to 2040

Year	Baseline	In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations	Percentage Change from Baseline		
					In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations
1994	164,911	164,911	164,911	164,911	0.00	0.00	0.00
1995	171,358	171,358	171,358	171,358	0.00	0.00	0.00
1996	166,266	166,266	166,518	166,266	0.00	0.15	0.00
1997	161,933	161,933	164,805	162,374	0.00	1.77	0.27
1998	164,289	164,465	168,753	169,324	0.11	2.72	3.06
1999	166,230	168,286	173,459	173,930	1.24	4.35	4.63
2000	167,442	171,100	174,748	179,142	2.19	4.36	6.99
2001	168,544	174,891	178,429	179,335	3.77	5.86	6.40
2002	169,583	175,802	179,505	178,968	3.67	5.85	5.53
2003	170,037	175,907	179,638	178,598	3.45	5.65	5.03
2004	170,492	175,751	179,534	176,087	3.08	5.30	3.28
2005	171,164	177,497	179,660	178,878	3.70	4.96	4.51
2006	172,083	177,134	178,309	180,485	2.94	3.62	4.88
2007	172,711	178,011	178,126	180,447	3.07	3.14	4.48
2008	172,872	178,260	177,675	180,584	3.12	2.78	4.46
2009	173,117	176,538	178,188	180,683	1.98	2.89	4.37
2010	173,384	175,662	182,791	179,987	1.31	5.43	3.81
2011	173,510	175,779	182,712	180,375	1.31	5.30	3.96
2012	173,592	176,053	182,530	180,493	1.42	5.15	3.98
2013	174,083	176,552	183,713	180,971	1.42	5.53	3.96
2014	175,088	177,532	184,499	181,645	1.40	5.38	3.75
2015	176,010	178,195	185,178	182,393	1.24	5.21	3.63
2016	176,956	179,240	185,941	183,062	1.29	5.08	3.45
2017	178,395	180,450	187,198	183,334	1.15	4.93	2.77
2018	180,346	179,794	188,953	184,308	-0.31	4.77	2.20
2019	182,193	181,541	189,994	184,984	-0.36	4.28	1.53
2020	184,021	182,983	186,968	184,399	-0.56	1.60	0.21
2021	185,904	184,310	189,338	186,681	-0.86	1.85	0.42
2022	187,901	186,578	191,476	188,528	-0.70	1.90	0.33
2023	189,590	188,300	193,214	189,986	-0.68	1.91	0.21
2024	190,870	189,729	193,585	191,029	-0.60	1.42	0.08
2025	192,301	192,264	194,669	192,245	-0.02	1.23	-0.03
2026	193,882	193,820	195,292	193,867	-0.03	0.73	-0.01
2027	195,450	195,283	196,840	195,221	-0.09	0.71	-0.12
2028	196,888	196,708	197,355	196,713	-0.09	0.24	-0.09
2029	198,204	198,036	198,249	198,074	-0.09	0.02	-0.07
2030	199,424	199,356	199,451	199,426	-0.03	0.01	0.00
2031	200,605	200,634	200,800	200,759	0.01	0.10	0.08
2032	201,662	201,689	201,919	201,851	0.01	0.13	0.09
2033	202,674	202,689	202,812	202,751	0.01	0.07	0.04
2034	203,691	203,706	203,760	203,718	0.01	0.03	0.01
2035	204,733	204,748	204,791	204,749	0.01	0.03	0.01
2036	205,774	205,788	205,893	205,792	0.01	0.06	0.01
2037	206,796	206,810	206,904	206,817	0.01	0.05	0.01
2038	207,808	207,822	207,915	207,829	0.01	0.05	0.01
2039	208,828	208,842	208,935	208,849	0.01	0.05	0.01
2040	209,851	209,866	209,958	209,873	0.01	0.05	0.01

Table H.3.2.9 Tri-Cities MSA Population with the Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives (Change from Baseline Estimate), 1994 to 2040

Year	Baseline	Ex Situ Extensive Separation	Ex Situ/In Situ Combination	Phased Implementation		Percentage Change from Baseline			
				Phase 1	Total	Ex Situ Extensive Separation	Ex Situ/In Situ Combination	Phased Implementation	
								Phase 1	Total
1994	164,911	164,911	164,911	164,911	164,911	0.00	0.00	0.00	0.00
1995	171,358	171,358	171,358	171,358	171,358	0.00	0.00	0.00	0.00
1996	166,266	166,475	166,420	166,293	166,293	0.13	0.09	0.02	0.02
1997	161,933	164,628	163,685	162,418	162,418	1.66	1.08	0.30	0.30
1998	164,289	171,381	167,010	167,128	167,128	4.32	1.66	1.73	1.73
1999	166,230	174,943	170,625	173,280	173,280	5.24	2.64	4.24	4.24
2000	167,442	172,157	171,887	176,048	176,048	2.82	2.66	5.14	5.14
2001	168,544	171,554	174,559	175,311	175,311	1.79	3.57	4.01	4.01
2002	169,583	177,934	175,576	171,125	171,123	4.92	3.53	0.91	0.91
2003	170,037	184,689	175,814	170,498	170,473	8.62	3.40	0.27	0.26
2004	170,492	188,324	175,910	171,699	171,780	10.46	3.18	0.71	0.76
2005	171,164	182,467	176,255	172,453	173,731	6.60	2.97	0.75	1.50
2006	172,083	179,648	175,777	173,384	176,807	4.40	2.15	0.76	2.75
2007	172,711	177,545	175,914	174,133	179,118	2.80	1.85	0.82	3.71
2008	172,872	175,398	175,716	174,264	181,960	1.46	1.65	0.81	5.26
2009	173,117	176,976	176,064	174,505	182,484	2.23	1.70	0.80	5.41
2010	173,384	182,068	178,879	174,772	183,882	5.01	3.17	0.80	6.05
2011	173,510	182,014	178,925	174,898	185,101	4.90	3.12	0.80	6.68
2012	173,592	181,709	178,866	175,092	183,562	4.68	3.04	0.86	5.74
2013	174,083	182,152	179,774	176,662	181,171	4.64	3.27	1.48	4.07
2014	175,088	182,829	180,644	177,115	183,559	4.42	3.17	1.16	4.22
2015	176,010	183,602	181,400	175,234	184,352	4.31	3.06	-0.44	5.24
2016	176,956	184,375	182,260	176,859	185,195	4.19	3.00	-0.05	4.66
2017	178,395	185,632	183,604	178,395	186,984	4.06	2.92	0.00	4.81
2018	180,346	187,297	185,429	180,346	188,863	3.85	2.82	0.00	4.72
2019	182,193	187,534	186,781	182,193	190,670	2.93	2.52	0.00	4.65
2020	184,021	185,473	185,803	184,021	192,204	0.79	0.97	0.00	4.45
2021	185,904	188,022	187,919	185,904	193,870	1.14	1.08	0.00	4.29
2022	187,901	190,089	190,018	187,901	195,201	1.16	1.13	0.00	3.89
2023	189,590	191,756	191,720	189,590	198,353	1.14	1.12	0.00	4.62
2024	190,870	192,458	192,215	190,870	198,354	0.83	0.70	0.00	3.92
2025	192,301	193,820	193,828	192,301	195,739	0.79	0.79	0.00	1.79
2026	193,882	194,221	194,599	193,882	196,772	0.17	0.37	0.00	1.49
2027	195,450	196,005	196,176	195,450	195,625	0.28	0.37	0.00	0.09
2028	196,888	197,241	197,055	196,888	197,681	0.18	0.08	0.00	0.40
2029	198,204	198,398	198,133	198,204	198,431	0.10	-0.04	0.00	0.11
2030	199,424	199,467	199,399	199,424	199,858	0.02	-0.01	0.00	0.22
2031	200,605	200,800	200,737	200,605	200,932	0.10	0.07	0.00	0.16
2032	201,662	201,919	201,830	201,662	201,635	0.13	0.08	0.00	-0.01
2033	202,674	202,812	202,764	202,674	202,742	0.07	0.04	0.00	0.03
2034	203,691	203,760	203,740	203,691	203,772	0.03	0.02	0.00	0.04
2035	204,733	204,781	204,775	204,733	204,811	0.02	0.02	0.00	0.04
2036	205,774	205,794	205,851	205,774	205,822	0.01	0.04	0.00	0.02
2037	206,796	206,828	206,867	206,796	206,852	0.02	0.03	0.00	0.03
2038	207,808	207,841	207,878	207,808	207,865	0.02	0.03	0.00	0.03
2039	208,828	208,861	208,898	208,828	208,885	0.02	0.03	0.00	0.03
2040	209,851	209,884	209,921	209,851	209,903	0.02	0.03	0.00	0.02

Table H.3.2.10 Tri-Cities MSA Taxable Retail Sales with the No Action, Long-Term Management, and In Situ Fill and Cap Alternatives (Change from Baseline Estimate), 1994 to 2040 (\$ Millions)

Year	Baseline	No Action	Long-Term Management	In Situ Fill and Cap	Percentage Change from Baseline		
					No Action	Long-Term Management	In Situ Fill and Cap
1994	513	513	513	513	0.00	0.00	-0.04
1995	646	646	646	646	0.00	0.00	0.06
1996	706	706	706	706	0.00	0.00	0.01
1997	746	746	746	746	0.00	0.00	-0.03
1998	818	818	818	818	0.00	0.00	-0.02
1999	898	898	898	898	0.00	0.00	-0.04
2000	977	977	977	978	0.00	0.00	0.07
2001	1,055	1,055	1,055	1,058	0.00	0.00	0.27
2002	1,132	1,132	1,132	1,135	0.00	0.00	0.26
2003	1,206	1,206	1,206	1,208	0.00	0.00	0.20
2004	1,278	1,278	1,278	1,281	0.00	0.00	0.25
2005	1,351	1,351	1,351	1,354	0.00	0.02	0.23
2006	1,426	1,426	1,426	1,428	0.01	0.19	0.17
2007	1,499	1,501	1,501	1,502	0.08	0.24	0.18
2008	1,570	1,572	1,572	1,573	0.12	0.52	0.20
2009	1,640	1,644	1,644	1,642	0.23	0.47	0.12
2010	1,710	1,714	1,714	1,712	0.24	0.50	0.12
2011	1,779	1,784	1,784	1,782	0.25	0.53	0.16
2012	1,848	1,853	1,853	1,851	0.25	0.60	0.17
2013	1,919	1,924	1,924	1,921	0.27	0.61	0.12
2014	1,993	1,999	1,999	1,996	0.27	0.62	0.14
2015	2,069	2,074	2,074	2,071	0.27	0.71	0.12
2016	2,144	2,150	2,150	2,147	0.28	0.69	0.13
2017	2,223	2,229	2,229	2,226	0.28	0.82	0.14
2018	2,305	2,313	2,313	2,308	0.31	0.83	0.11
2019	2,389	2,396	2,396	2,391	0.33	0.92	0.10
2020	2,472	2,481	2,481	2,475	0.34	0.92	0.12
2021	2,556	2,565	2,565	2,558	0.34	0.96	0.08
2022	2,640	2,650	2,650	2,642	0.35	0.95	0.06
2023	2,724	2,733	2,733	2,724	0.35	1.07	0.02
2024	2,804	2,814	2,814	2,801	0.37	2.00	-0.10
2025	2,884	2,901	2,901	2,884	0.59	1.95	0.01
2026	2,965	2,984	2,984	2,964	0.64	1.85	-0.03
2027	3,046	3,065	3,065	3,044	0.63	1.82	-0.06
2028	3,126	3,146	3,146	3,125	0.61	1.82	-0.04
2029	3,206	3,225	3,225	3,204	0.60	1.88	-0.06
2030	3,285	3,305	3,305	3,284	0.61	1.98	-0.02
2031	3,363	3,383	3,384	3,363	0.61	2.23	0.01
2032	3,440	3,461	3,463	3,440	0.60	2.28	0.00
2033	3,517	3,538	3,541	3,517	0.59	2.66	0.01
2034	3,593	3,614	3,621	3,593	0.58	2.54	-0.01
2035	3,670	3,691	3,698	3,670	0.57	2.51	0.00
2036	3,747	3,768	3,775	3,747	0.56	2.50	0.01
2037	3,823	3,844	3,851	3,823	0.54	2.41	-0.01
2038	3,900	3,921	3,927	3,900	0.53	1.65	0.01
2039	3,976	3,997	3,998	3,976	0.52	1.82	-0.01
2040	4,053	4,074	4,074	4,053	0.51	1.84	0.00

Table H.3.2.11 Tri-Cities MSA Taxable Retail Sales with the In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives (Change from Baseline Estimate), 1994 to 2040 (\$ Millions)

Year	Baseline	In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations	Percentage Change from Baseline		
					In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations
1994	513	513	513	513	0.00	0.00	-0.04
1995	646	646	646	646	0.00	0.00	0.06
1996	706	706	707	706	0.00	0.20	0.01
1997	746	746	763	749	0.00	2.28	0.38
1998	818	819	850	848	0.12	3.83	3.64
1999	898	911	951	953	1.36	5.80	6.08
2000	977	1,002	1,037	1,063	2.57	6.09	8.77
2001	1,055	1,100	1,132	1,146	4.26	7.28	8.62
2002	1,132	1,183	1,215	1,217	4.49	7.31	7.50
2003	1,206	1,256	1,289	1,283	4.21	6.88	6.42
2004	1,278	1,325	1,358	1,336	3.70	6.25	4.55
2005	1,351	1,403	1,427	1,415	3.87	5.60	4.74
2006	1,426	1,472	1,487	1,495	3.28	4.30	4.87
2007	1,499	1,545	1,551	1,567	3.07	3.45	4.52
2008	1,570	1,616	1,615	1,637	2.96	2.87	4.27
2009	1,640	1,675	1,684	1,706	2.15	2.68	4.02
2010	1,710	1,735	1,779	1,770	1.46	4.02	3.51
2011	1,779	1,801	1,855	1,839	1.21	4.27	3.36
2012	1,848	1,869	1,925	1,908	1.15	4.16	3.25
2013	1,919	1,940	2,000	1,978	1.12	4.23	3.09
2014	1,993	2,014	2,075	2,051	1.06	4.08	2.90
2015	2,069	2,088	2,149	2,125	0.95	3.87	2.73
2016	2,144	2,164	2,223	2,198	0.92	3.66	2.51
2017	2,223	2,241	2,300	2,269	0.83	3.46	2.08
2018	2,305	2,308	2,381	2,344	0.13	3.27	1.67
2019	2,389	2,386	2,459	2,418	-0.11	2.94	1.23
2020	2,472	2,465	2,513	2,484	-0.28	1.64	0.48
2021	2,556	2,544	2,589	2,564	-0.45	1.31	0.32
2022	2,640	2,629	2,672	2,647	-0.43	1.20	0.25
2023	2,724	2,712	2,755	2,728	-0.41	1.16	0.17
2024	2,804	2,793	2,830	2,806	-0.37	0.93	0.08
2025	2,884	2,880	2,906	2,884	-0.13	0.78	0.01
2026	2,965	2,963	2,980	2,965	-0.05	0.53	0.01
2027	3,046	3,044	3,059	3,045	-0.05	0.44	-0.03
2028	3,126	3,125	3,134	3,125	-0.05	0.23	-0.04
2029	3,206	3,205	3,209	3,205	-0.05	0.08	-0.03
2030	3,285	3,284	3,286	3,284	-0.03	0.03	-0.02
2031	3,363	3,363	3,364	3,364	0.00	0.04	0.04
2032	3,440	3,440	3,442	3,441	0.00	0.06	0.03
2033	3,517	3,517	3,518	3,518	0.00	0.04	0.03
2034	3,593	3,594	3,594	3,594	0.00	0.03	0.02
2035	3,670	3,670	3,671	3,670	0.00	0.02	0.00
2036	3,747	3,747	3,748	3,747	0.00	0.02	0.01
2037	3,823	3,823	3,824	3,823	0.00	0.02	-0.01
2038	3,900	3,900	3,901	3,900	0.00	0.02	0.01
2039	3,976	3,976	3,977	3,976	0.00	0.02	-0.01
2040	4,053	4,053	4,054	4,053	0.00	0.02	0.00

Table H.3.2.12 Tri-Cities MSA Taxable Retail Sales with the Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives (Change from Baseline Estimate), 1994 to 2040 (\$ Millions)

Year	Baseline	Ex Situ Extensive Separation	Ex Situ/In Situ Combination	Phased Implementation		Percentage Change from Baseline			
				Phase 1	Total	Ex Situ Extensive Separations	Ex Situ/In Situ Combination	Phased Implementation	
								Phase 1	Total
1994	513	513	513	513	513	-0.04	0.00	0.00	0.04
1995	646	646	646	646	646	0.06	0.00	0.00	-0.06
1996	706	707	707	706	706	0.16	0.11	0.01	0.00
1997	746	762	757	749	749	2.12	1.38	1.38	0.40
1998	818	864	837	835	835	5.60	2.33	2.10	2.13
1999	898	964	930	945	945	7.30	3.53	5.15	5.20
2000	977	1,026	1,014	1,042	1,042	4.98	3.70	6.65	6.68
2001	1,055	1,089	1,102	1,116	1,116	3.21	4.43	5.75	5.76
2002	1,132	1,191	1,182	1,162	1,162	5.20	4.43	2.60	2.61
2003	1,206	1,310	1,256	1,218	1,218	8.66	4.15	1.04	1.00
2004	1,278	1,415	1,326	1,289	1,289	10.74	3.76	0.88	0.89
2005	1,351	1,462	1,396	1,362	1,370	8.22	3.36	0.82	1.37
2006	1,426	1,507	1,462	1,437	1,459	5.71	2.56	0.79	2.31
2007	1,499	1,554	1,530	1,511	1,547	3.65	2.05	0.80	3.22
2008	1,570	1,603	1,597	1,582	1,638	2.11	1.70	0.77	4.35
2009	1,640	1,673	1,666	1,652	1,717	2.01	1.58	0.73	4.68
2010	1,710	1,771	1,750	1,722	1,796	3.57	2.36	0.71	5.04
2011	1,779	1,849	1,824	1,791	1,875	3.92	2.51	0.67	5.39
2012	1,848	1,918	1,893	1,861	1,937	3.79	2.45	0.68	4.83
2013	1,919	1,989	1,967	1,938	1,990	3.66	2.50	1.00	3.67
2014	1,993	2,061	2,041	2,011	2,066	3.40	2.41	0.91	3.65
2015	2,069	2,135	2,116	2,070	2,141	3.21	2.28	0.08	3.52
2016	2,144	2,209	2,191	2,144	2,216	3.02	2.16	0.00	3.35
2017	2,223	2,286	2,268	2,223	2,296	2.84	2.05	0.00	3.29
2018	2,305	2,367	2,350	2,305	2,379	2.67	1.93	0.00	3.21
2019	2,389	2,440	2,430	2,389	2,462	2.15	1.73	0.00	3.06
2020	2,472	2,498	2,496	2,472	2,544	1.05	0.97	0.00	2.90
2021	2,556	2,577	2,576	2,556	2,626	0.83	0.77	0.00	2.77
2022	2,640	2,660	2,659	2,640	2,706	0.74	0.71	0.00	2.50
2023	2,724	2,743	2,742	2,724	2,796	0.72	0.68	0.00	2.64
2024	2,804	2,819	2,818	2,804	2,871	0.55	0.50	0.00	2.39
2025	2,884	2,898	2,897	2,884	2,926	0.49	0.47	0.00	1.47
2026	2,965	2,971	2,973	2,965	2,996	0.21	0.29	0.00	1.04
2027	3,046	3,051	3,053	3,046	3,057	0.17	0.23	0.00	0.37
2028	3,126	3,130	3,130	3,126	3,135	0.12	0.11	0.00	0.28
2029	3,206	3,208	3,207	3,206	3,210	0.06	0.02	0.00	0.13
2030	3,285	3,286	3,285	3,285	3,289	0.04	0.00	0.00	0.11
2031	3,363	3,364	3,364	3,363	3,366	0.04	0.02	0.00	0.09
2032	3,440	3,442	3,441	3,440	3,441	0.06	0.03	0.00	0.03
2033	3,517	3,518	3,518	3,517	3,518	0.03	0.03	0.00	0.01
2034	3,593	3,594	3,594	3,593	3,594	0.02	0.02	0.00	0.03
2035	3,670	3,671	3,671	3,670	3,671	0.03	0.01	0.00	0.02
2036	3,747	3,747	3,747	3,747	3,747	0.01	0.02	0.00	0.01
2037	3,823	3,824	3,824	3,823	3,824	0.02	0.02	0.00	0.02
2038	3,900	3,900	3,900	3,900	3,900	0.01	0.02	0.00	0.01
2039	3,976	3,977	3,977	3,976	3,977	0.02	0.02	0.00	0.02
2040	4,053	4,053	4,053	4,052	4,053	0.00	0.01	0.00	0.00

Table H.3.2.13 Tri-Cities MSA Home Prices with the No Action, Long-Term Management, and In Situ Fill and Cap Alternatives (Change from Baseline Estimate), 1994 to 2040 (\$ Thousands)

Year	Baseline	No Action	Long-Term Management	In Situ Fill and Cap	Percentage Change from Baseline		
					No Action	Long-Term Management	In Situ Fill and Cap
1994	103	103	103	103	0.00	0.00	-0.29
1995	115	115	115	114	0.00	0.00	-0.44
1996	107	107	107	107	0.00	0.00	0.38
1997	100	100	100	100	0.00	0.00	0.10
1998	104	104	104	104	0.00	0.00	-0.29
1999	108	108	108	108	0.00	0.00	0.00
2000	111	111	111	111	0.00	0.00	0.45
2001	113	113	113	114	0.00	0.00	0.97
2002	115	115	115	116	0.00	0.00	0.78
2003	116	116	116	117	0.00	0.00	0.52
2004	118	118	118	118	0.00	0.00	0.34
2005	119	119	119	120	0.00	0.02	0.67
2006	121	121	121	122	0.00	0.19	0.58
2007	123	123	123	123	0.24	0.24	0.16
2008	124	124	124	124	0.32	0.52	0.32
2009	125	125	125	125	0.72	0.47	0.40
2010	126	126	126	126	0.64	0.50	0.40
2011	126	127	127	127	0.63	0.53	0.63
2012	127	128	128	127	0.71	0.60	0.16
2013	128	129	129	129	0.86	0.61	0.70
2014	130	131	131	131	0.84	0.62	0.54
2015	132	133	133	133	0.83	0.71	0.53
2016	134	136	136	135	0.89	0.69	0.45
2017	137	139	139	138	0.87	0.82	0.51
2018	141	143	143	142	1.06	0.83	0.71
2019	145	146	146	145	1.04	0.92	0.28
2020	148	150	150	149	1.15	0.92	0.61
2021	152	154	154	152	1.19	0.96	0.20
2022	156	157	157	156	1.16	0.95	0.26
2023	159	161	161	159	1.13	1.07	0.06
2024	162	164	164	161	1.24	2.00	-0.31
2025	164	168	168	165	2.31	1.95	0.36
2026	168	171	171	167	2.27	1.85	-0.30
2027	171	174	174	170	2.17	1.82	-0.35
2028	174	177	177	173	2.07	1.82	-0.29
2029	176	180	180	176	2.10	1.88	-0.06
2030	179	183	183	179	2.13	1.98	0.17
2031	181	185	185	181	2.21	2.23	-0.06
2032	183	187	188	183	2.18	2.28	-0.22
2033	186	190	190	186	2.10	2.66	0.22
2034	188	192	193	188	2.08	2.54	0.11
2035	190	194	195	190	2.11	2.51	0.00
2036	192	196	198	192	2.08	2.50	-0.10
2037	194	198	200	194	2.06	2.41	-0.21
2038	197	201	202	197	2.03	1.65	0.20
2039	199	203	202	199	2.01	1.82	0.10
2040	201	205	205	201	1.99	1.84	0.00

Table H.3.2.14 Tri-Cities MSA Home Prices with the In Situ Vitrification, Ex Situ Intermediate Separations, and Ex Situ No Separations Alternatives (Change from Baseline Estimate), 1994 to 2040 (\$ Thousands)

Year	Baseline	In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations	Percentage Change from Baseline		
					In Situ Vitrification	Ex Situ Intermediate Separations	Ex Situ No Separations
1994	103	103	103	103	0.00	0.00	-0.29
1995	115	115	115	114	0.00	0.00	-0.44
1996	107	107	107	107	0.00	0.38	0.38
1997	100	100	105	101	0.00	4.80	1.10
1998	104	105	112	113	0.29	7.09	8.34
1999	108	111	120	121	3.15	11.11	12.04
2000	111	117	123	130	5.52	10.95	17.65
2001	113	123	129	131	9.30	14.44	16.03
2002	115	125	132	131	8.95	14.25	13.81
2003	116	126	132	131	8.33	13.57	12.54
2004	118	126	133	127	7.40	12.76	7.99
2005	119	130	133	132	8.81	11.83	10.74
2006	121	130	132	135	6.84	8.49	11.29
2007	123	132	132	136	7.17	7.33	10.75
2008	124	133	132	136	7.20	6.39	10.03
2009	125	130	133	137	4.58	6.67	10.04
2010	126	129	141	136	2.95	12.35	8.37
2011	126	130	141	138	2.93	12.04	9.35
2012	127	131	142	138	3.23	11.67	8.83
2013	128	132	144	140	3.20	12.49	9.29
2014	130	134	146	141	3.07	11.97	8.21
2015	132	136	148	143	2.72	11.49	8.09
2016	134	138	149	145	2.83	11.09	7.89
2017	137	141	152	145	2.48	10.56	5.61
2018	141	140	155	148	-0.64	10.14	4.96
2019	145	144	158	149	-0.76	8.92	3.04
2020	148	146	153	149	-1.15	3.31	0.61
2021	152	149	157	153	-1.71	3.76	0.86
2022	156	153	162	157	-1.41	3.79	0.90
2023	159	157	165	160	-1.38	3.71	0.69
2024	162	160	166	162	-1.18	2.79	0.31
2025	164	164	168	164	-0.06	2.37	-0.24
2026	168	167	170	167	-0.06	1.37	-0.30
2027	171	170	173	170	-0.18	1.35	-0.35
2028	174	173	174	173	-0.17	0.40	-0.29
2029	176	176	176	176	-0.11	0.06	-0.06
2030	179	179	179	179	-0.06	0.00	0.17
2031	181	181	182	181	0.06	0.22	-0.06
2032	183	183	184	184	0.00	0.22	0.33
2033	186	186	186	186	0.00	0.11	0.22
2034	188	188	188	188	0.00	0.05	0.11
2035	190	190	190	190	0.00	0.05	0.00
2036	192	192	192	192	0.00	0.10	-0.10
2037	194	194	195	194	0.00	0.10	-0.21
2038	197	197	197	197	0.00	0.10	0.20
2039	199	199	199	199	0.00	0.10	0.10
2040	201	201	201	201	0.00	0.10	0.00

Table H.3.2.15 Tri-Cities MSA Home Prices with the Ex Situ Extensive Separations, Ex Situ/In Situ Combination, and Phased Implementation Alternatives (Change from Baseline Estimate), 1994 to 2040 (\$ Thousands)

Year	Baseline	Ex Situ Extensive Separation	Ex Situ/ In Situ Combination	Phased Implementation		Percentage Change from Baseline			
				Phase 1	Total	Ex Situ Extensive Separations	Ex Situ/ In Situ Combination	Phased Implementation	
								Phase 1	Total
1994	103	103	103	103	103	-0.29	0.00	0.00	0.29
1995	115	114	115	115	115	-0.44	0.00	0.00	0.44
1996	107	107	107	107	107	0.38	0.19	0.00	-0.37
1997	100	104	103	101	101	4.10	2.90	0.80	0.70
1998	104	116	109	109	109	11.22	4.31	4.51	4.81
1999	108	122	115	120	120	12.96	6.76	10.83	10.83
2000	111	118	118	125	125	6.79	6.70	12.94	12.43
2001	113	118	123	124	124	4.52	8.77	9.92	9.82
2002	115	129	125	118	118	12.08	8.60	2.17	2.26
2003	116	141	126	117	117	21.13	8.16	0.60	0.95
2004	118	147	127	120	120	25.00	7.65	1.70	1.44
2005	119	138	128	121	124	15.77	7.13	1.85	3.78
2006	121	134	127	123	129	10.47	5.03	1.73	6.69
2007	123	131	128	125	133	6.68	4.32	1.95	8.46
2008	124	128	128	126	139	3.56	3.80	1.86	11.77
2009	125	131	129	127	140	5.22	3.94	1.85	12.00
2010	126	140	135	128	143	11.55	7.17	1.75	14.24
2011	126	140	135	129	145	10.94	7.05	1.82	15.32
2012	127	140	136	129	143	10.41	6.86	1.97	12.83
2013	128	141	138	132	140	10.07	7.34	3.36	9.22
2014	130	143	140	134	144	9.75	7.06	2.61	11.00
2015	132	145	141	131	146	9.60	6.73	-0.91	10.68
2016	134	147	143	134	148	9.38	6.55	-0.15	10.45
2017	137	149	146	137	152	8.52	6.26	0.00	10.58
2018	141	153	149	141	155	8.51	5.96	0.00	10.00
2019	145	153	152	145	159	5.81	5.26	0.00	9.38
2020	148	151	151	148	162	1.96	2.03	0.00	9.19
2021	152	155	155	152	165	2.18	2.24	0.00	8.49
2022	156	159	159	156	168	2.19	2.25	0.00	7.44
2023	159	162	162	159	173	1.95	2.20	0.00	8.99
2024	162	164	164	162	174	1.55	1.36	0.00	7.95
2025	164	167	167	164	170	1.58	1.52	0.00	3.66
2026	168	168	169	168	172	0.30	0.72	0.00	3.11
2027	171	171	172	171	171	0.23	0.70	0.00	-0.06
2028	174	174	174	174	175	0.29	0.12	0.00	1.04
2029	176	176	176	176	177	-0.06	-0.06	0.00	0.28
2030	179	179	179	179	179	0.17	-0.06	0.00	0.22
2031	181	181	181	181	182	-0.06	0.11	0.00	0.39
2032	183	184	184	183	183	0.33	0.16	0.00	0.16
2033	186	186	186	186	186	0.22	0.05	0.00	-0.16
2034	188	188	188	188	188	0.11	0.05	0.00	-0.05
2035	190	190	190	190	190	0.00	0.05	0.00	0.05
2036	192	192	192	192	192	-0.10	0.05	0.00	0.16
2037	194	194	195	194	195	-0.21	0.05	0.00	0.26
2038	197	197	197	197	197	0.20	0.05	0.00	-0.15
2039	199	199	199	199	199	0.10	0.05	0.00	-0.05
2040	201	201	201	201	201	0.00	0.05	0.00	0.05

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APPENDIX I
AFFECTED ENVIRONMENT

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ACRONYMS AND ABBREVIATIONS

BLM	Bureau of Land Management
C	centigrade
CFR	Code of Federal Regulations
CLUP	Comprehensive Land Use Plan
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
F	Fahrenheit
FEALE	Fitzner Eberhardt Arid Lands Ecology Reserve
HMS	Hanford Meteorological Station
HSDP	Hanford Site Development Plan
LOS	Level of Service
MMI	Mercalli Intensities
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
PM-10	particulate matter
PUREX	Plutonium-Uranium Extraction Plant
SCS	Soil Conservation Service
SST	single-shell tank
TRAC	Track Radioactive Component
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TWRS	Tank Waste Remediation System
USFWS	U.S. Fish and Wildlife Service

NAMES AND SYMBOLS FOR UNITS OF MEASURE AND RADIOACTIVITY**Length**

cm centimeter
ft foot
in. inch
km kilometer
m meter
mi mile

Area

ha hectare
ac acre
km² square kilometer
mi² square mile
ft² square foot

Volume

cm³ cubic centimeter
ft³ cubic foot
gal gallon
L liter
m³ cubic meter
ppb parts per billion
ppm parts per million
yd³ cubic yard

Mass

g gram
kg kilogram
mg milligram
lb pound
mt metric ton

Radioactivity

Ci curie
mCi millicurie (1.0E-03 Ci)
μCi microcurie (1.0E-06 Ci)
nCi nanocurie (1.0E-09 Ci)
pCi picocurie (1.0E-12 Ci)

APPENDIX I

AFFECTED ENVIRONMENT

I.1.0 INTRODUCTION

This appendix describes the environmental setting for the proposed Tank Waste Remediation System (TWRS) activities at the Hanford Site. By describing the environmental conditions that could be potentially impacted by TWRS activities, the appendix provides the context and basis for analyzing the impacts of the Environmental Impact Statement (EIS) alternatives. Data to support comparisons between the potential impacts of the various EIS alternatives are also provided within this appendix. Existing conditions are discussed for all aspects of the environment (soil, groundwater, air, plant and animal species habitats, socioeconomic conditions, biological and ecological resources, cultural resources, land use, visual resources, noise, and transportation). Additional details on existing environmental conditions can be found in the Hanford Site National Environmental Policy Act (NEPA) Characterization Report (Cushing 1994 and 1995), the Hanford Environmental Report for Calendar Year 1994 (PNL 1995), and in other references cited within the text. Information on the potential TWRS borrow sites was obtained largely from the Site Evaluation Report for Candidate Basalt Quarry Sites (Duranceau 1995).

The Hanford Site is in the semi-arid region of the Columbia Plateau in southeastern Washington State (Figure I.1.0.1). The Hanford Site occupies about 1,450 square kilometers (km²) 560 square miles [mi²] of shrub and grasslands just north of Richland, Washington. The majority of this large land area, with restricted public access, provides a buffer to the smaller areas within the Hanford Site historically used for producing nuclear materials, waste storage, and waste disposal. About 6 percent of the land has been disturbed and is actively used. The Hanford Site extends approximately 77 km (48 mi) north to south and 61 km (38 mi) east to west.

The Columbia River flows through the northern part of the Hanford Site, turning south to form part of its eastern boundary. The Yakima River runs along part of the southern boundary and joins the Columbia River at the city of Richland. Adjoining lands to the west, north, and east are principally range and agricultural land. The cities of Richland, Kennewick, and Pasco (also known as the Tri-Cities) comprise the nearest population centers and are located southeast of the Site.

I.1.1 GEOLOGY AND SOIL

Geologic information on the Hanford Site (Figure I.1.1.1) has been collected in connection with a variety of Site activities. Reports by Delaney (Delaney et al. 1991), Reidel (Reidel et al. 1992), and Cushing (Cushing 1994), summarizing the information collected during many of these activities, are the primary basis for the following overview of the Hanford Site's subsurface environment.

Figure I.1.0.1 Hanford Site Map and Vicinity

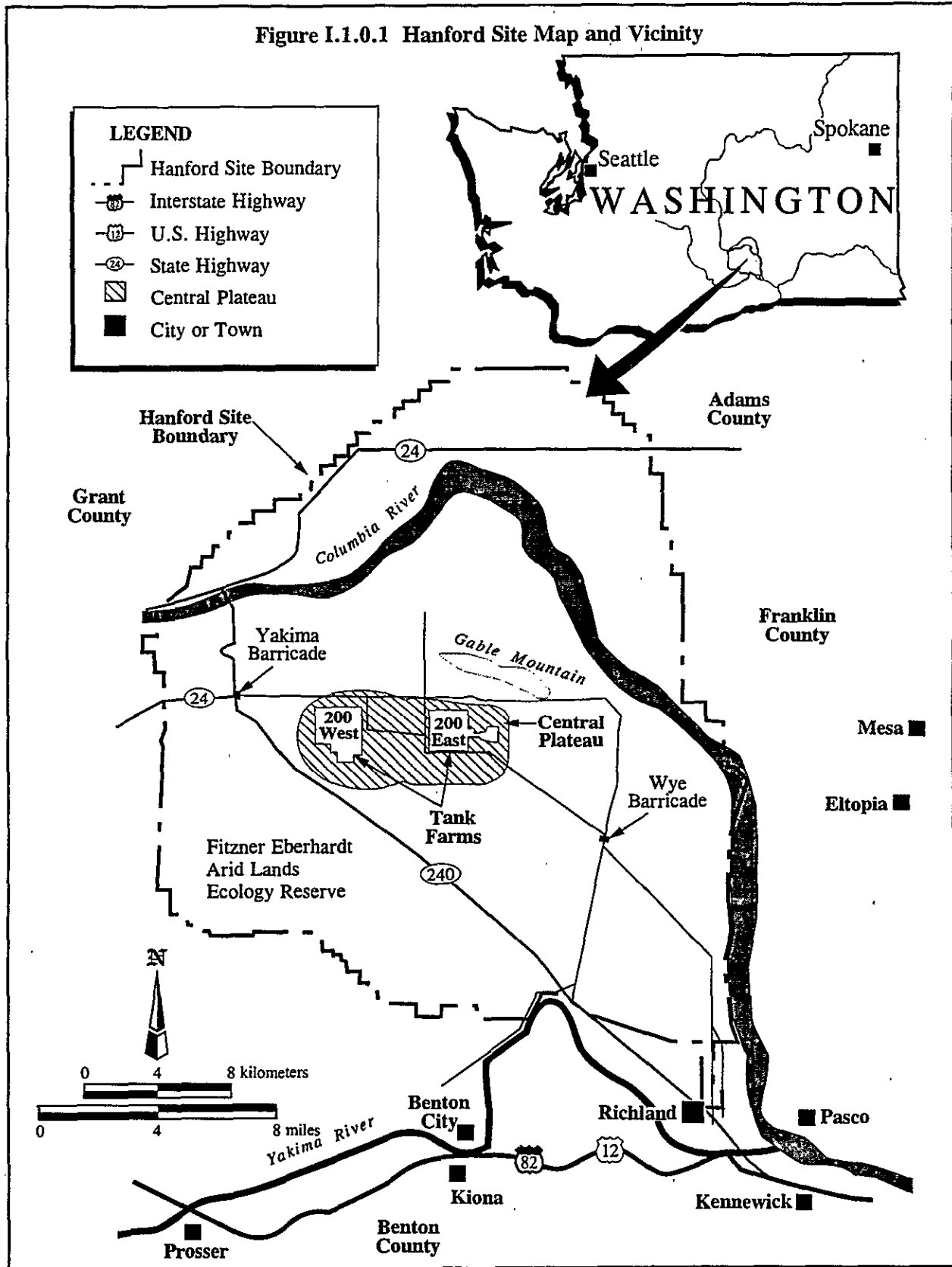
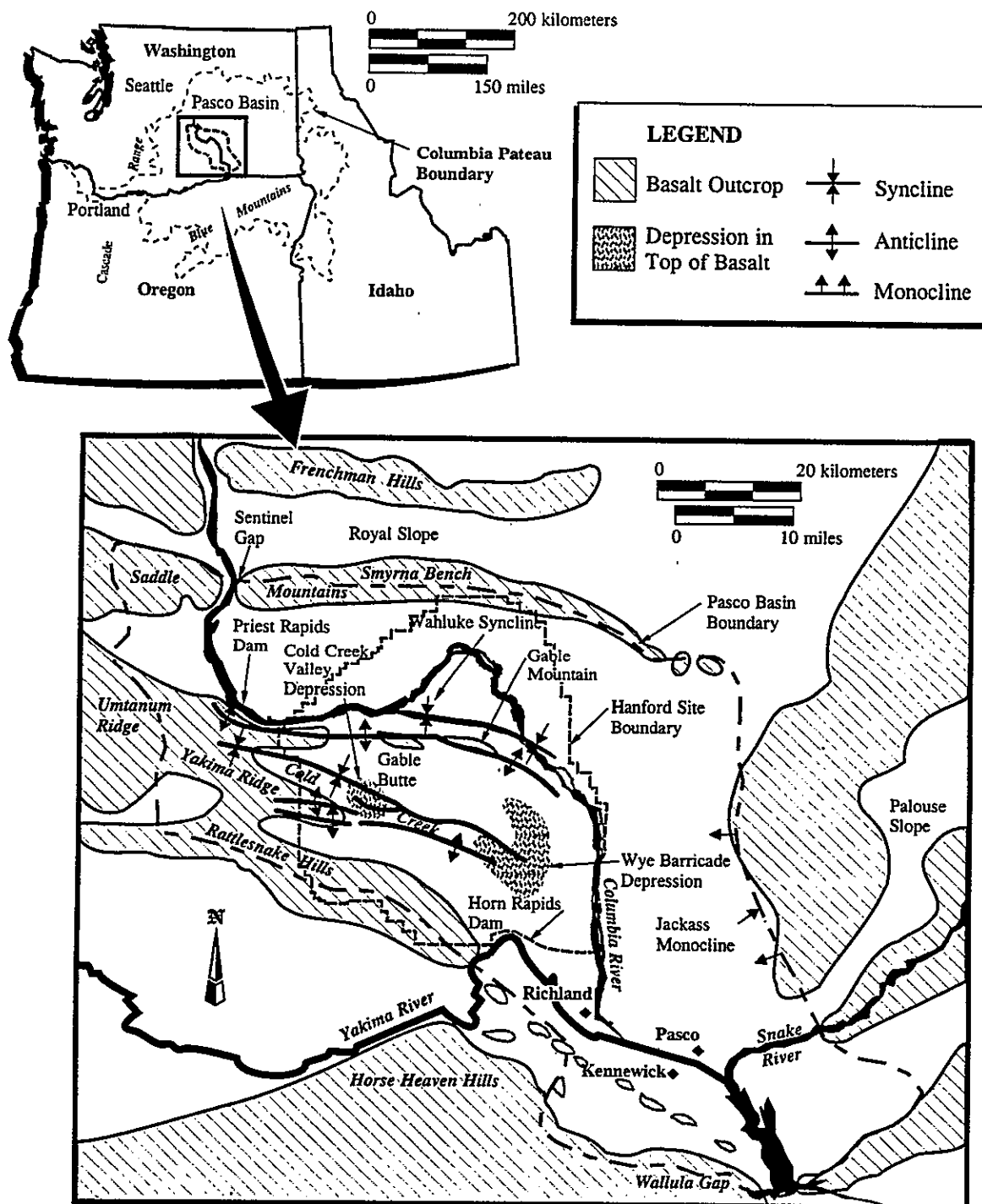


Figure I.1.1.1 Geographic Setting and General Structural Geology of the Pasco Basin and Hanford Site



SOURCE: Adapted from Lindsey 1992

The geology of the Hanford Site forms the framework for the Site's groundwater and surface water resources. Of particular relevance are: 1) the topography, which impacts surface water flows and infiltration; 2) the vadose zone, because of potential impacts associated with releases during proposed TWRS activities; and 3) the saturated sediments beneath the vadose zone that form the unconfined aquifer because of potential impacts from releases that pass through the vadose zone from proposed TWRS activities.

The geology and water resources sections focus primarily on conditions in the 200 Areas, where the tank waste and strontium (Sr) and cesium (Cs) capsules are located and where virtually all TWRS facilities, except for three potential borrow sites, would be located under any of the EIS alternatives. The potential Pit 30 borrow site, a possible source of sand and gravel, is located between the 200 East and 200 West Areas. The geologic setting of the Pit 30 area is the same as is described for the 200 Areas. The potential McGee Ranch and Vernita Quarry borrow sites, possible sources of silt (McGee) and basalt (Vernita), are located approximately 6 kilometers (km) (4 miles [mi]) north and west of the 200 West Area. Geologic conditions for the McGee Ranch and Vernita Quarry areas are briefly described in the following sections.

I.1.1.1 Topography and Geomorphology

The existing tank farms are on a broad flat area called the Central Plateau, which overlies an alluvial terrace (Figure I.1.1.1). The Central Plateau is in a portion of the Pasco Basin, a topographic, structural depression in the southwest corner of the Columbia Basin physiographic subprovince. This subprovince is characterized by generally low-relief hills with deeply incised river drainage. The Central Plateau's elevation is approximately 198 meters (m) (650 feet [ft]) to 229 m (750 ft) above sea level. The Plateau decreases in elevation to the north, northwest, and east toward the Columbia River. Plateau escarpments have elevation changes of 15 m (50 ft) to 30 m (100 ft). The proposed Vernita Quarry and McGee Ranch borrow sites are located to the west of the northern portions of the Central Plateau.

Observed landslide activity in the area is generally limited to the White Bluffs area east of the Hanford Site and the Rattlesnake Hills south of the Hanford Site. No landslide activity has been observed in the vicinity of the tank farms or the TWRS sites in the 200 East Area. The Pasco Basin is bounded on the north by the Saddle Mountains, on the west by Umtanum Ridge, Yakima Ridge, and the Rattlesnake Hills, on the south by Rattlesnake Mountain and the Rattlesnake Hills, and on the east by the Palouse Slope (Figure I.1.1.1).

The Pasco Basin is an area of generally low relief ranging from 120 m (390 ft) above mean sea level at the Columbia River level, to 230 m (750 ft) above mean sea level in the vicinity of the TWRS sites in the 200 East Area. Surface topography at the Hanford Site is the result of the uplift of anticlinal ridges, Pleistocene cataclysmic flooding, Holocene eolian activity, and landslides (Delaney et al. 1991). Uplift of the ridges began in the Miocene Epoch concurrent with the eruption of the flood basalts and continues to present. Cataclysmic flooding occurred when glacial ice dams in western Montana and northern Idaho were breached, allowing large volumes of water to spill across eastern and central

Washington State. Much of the landscape in the path of the floodwater was stripped of sediments and basalt bedrock was scoured, forming scabland topography (elevated areas underlain by flat-lying basalt flows that generally exhibit deep, dry channels scoured into the surface). The last major flood occurred approximately 13,000 years ago during the late Pleistocene Epoch.

Braided flood channels with giant water current ripples, bermounds (hummocky areas where grounded icebergs melted), and giant flood bars are among the landforms created by the flood that are apparent on the Hanford Site. Since the end of the Pleistocene Epoch, winds have reworked the flood sediments locally depositing sand dunes in the lower elevations and loess (wind-blown silt) around the margins of the Pasco Basin. Sand dunes generally have been stabilized by anchoring vegetation except in localized areas where they have been reactivated around disturbed vegetation and within the barchan dune complex in the west-central portion of the Site.

I.1.2 GEOLOGIC STRUCTURE

The Hanford Site lies in the Pasco Basin near the eastern limit of the Yakima Fold Belt. The Pasco Basin is a structural depression bounded by anticlinal ridges on the north, west, and south and a monocline on the east (Figure I.1.1.1). The Pasco Basin is divided by the Gable Mountain anticline in the Wahluke syncline to the north and the Cold Creek syncline to the south. Geologic materials that include basalts and sediments thicken into the Pasco Basin and generally reach maximum thickness in the Cold Creek syncline (Delaney et al.1991).

The 200 Areas are situated between the Gable Mountain anticline and the Cold Creek syncline (Figure I.1.1.1). The Gable Mountain anticline is of particular importance to groundwater flow in the unconfined aquifer. This anticline consists of a series of southeast to northwest trending folds (Trent 1992b). Portions of the Gable Mountain anticline have been uplifted high enough that basalt is above the current water table. These basalts have a low hydraulic conductivity and act as a barrier to horizontal groundwater flow in the unconfined aquifer.

The uppermost basalt underlying the 200 Areas is the Elephant Mountain Member of the Saddle Mountain Basalt Formation (Trent 1992a and Trent 1992b). North of the 200 East Area, the first basalt formation encountered in two adjacent boreholes (6-53-55 and 6-55-55) was the Rattlesnake Ridge interbed of the Ellensburg Formation (Trent 1992b) and the Elephant Mountain Member basalt flow was absent. The absence of the Elephant Mountain Member basalt flow is referred to as a "window" (Trent 1992a and Trent 1992b) and is probably erosional, formed during the Pleistocene cataclysmic flooding. There is no evidence for other substantial erosion into the top of the Elephant Mountain Member and no indication of erosional windows through the basalt into the underlying Rattlesnake Ridge interbed in the 200 West Area (Trent 1992a).

I.1.3 STRATIGRAPHY AND LITHOLOGY

A generalized stratigraphic column illustrating the nomenclature for the formations that underlie the Hanford Site is provided in Figures I.1.3.1 and I.1.3.2.

I.1.3.1 Columbia River Basalt Group

The Columbia River Basalt Group, which is a sequence of basaltic rock found typically on the ocean floor, erupted as basalt flows between 6 and 17 million years ago. These flows cover an area of more than 163,000 km² (63,000 mi²) and have an estimated volume of 174,000 km³ (40,800 mi³).

The thickness of basalt accumulations in the Pasco Basin is in excess of 3,000 m (10,000 ft) (Delaney et al. 1991). The Columbia River Basalt Group is divided into five formations (from oldest to youngest): Imnaha Basalt, Picture Gorge Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt. Only the Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt are exposed on the Hanford Site. The Elephant Mountain member of the Saddle Mountains Basalt forms the uppermost basalt unit beneath most of the Hanford Site, except near the 300 Area where the Ice Harbor member is present, and north of the Central Plateau near Gable Gap where the Saddle Mountains Basalt has been eroded down to the Umatilla member.

I.1.3.2 Ellensburg Formation

The Ellensburg Formation consists of a series of sedimentary units that are interbedded between many of the basalt flows of the Columbia River Basalt Group. The Ellensburg Formation generally displays volcanic characteristics produced by volcanic events in the Cascade Range, and silicic characteristics derived from erosion of the Rocky Mountains. At the Hanford Site, the Ellensburg Formation consists of a mix of sediments deposited by the ancestral Clearwater and Columbia Rivers (Delaney et al. 1991). The three uppermost units of the Ellensburg Formation at the Site are the Levey Interbed, confined to the vicinity of the 300 Area, and the Rattlesnake Ridge and Selah interbeds, found beneath most of the Hanford Site (Delaney et al. 1991).

I.1.3.3 Suprabasalt Sediments

The suprabasalt sediments are a sedimentary sequence overlying the basalts at the Site and include the Ringold and Hanford Formations. These sediments are up to approximately 230 m (750 ft) thick in the west-central Cold Creek syncline and pinch-out against the Saddle Mountains, Gable Mountain and Umtanum Ridge, Yakama Ridge, and Rattlesnake Hills anticlines. The suprabasalt sediments are dominated by laterally extensive deposits assigned to the late Miocene to Pliocene Ringold Formation and the Pleistocene Hanford Formation. The informally defined Plio-Pleistocene unit, early Palouse soil, and pre-Missoula gravels separate the Ringold Formation and Hanford Formation locally.

I.1.3.4 Ringold Formation

The Ringold Formation consists of semi-indurated clay, silt, pedogenically altered sediment, fine to coarse grained sand, and gravel. The Ringold Formation at the Site is up to 180 m (600 ft) thick in the deepest part of the Cold Creek Syncline south of the 200 West Area, but is largely absent in the

Figure I.1.3.1 Generalized Stratigraphy of the Hanford Site

Period	Epoch	Group	Formation	Isotopic Age Dates Years x 10 ⁶	Member (Formal and Informal)	Sediment Stratigraphy or Basalt Flows	
Quaternary	Holocene		Hanford		Surficial Units	Loess Sand Dunes Alluvium and Alluvial Fans Land Slides Talus Colluvium	
	Pleistocene				Touchet beds Pasco Gravels		
	Pliocene		Ringold			Plio-Pleistocene Unit	
Tertiary	Miocene	Columbia River Basalt Group	Saddle Mountains Basalt	8.5	Ice Harbor Member	basalt of Goose Island basalt of Martindale basalt of Basin City Levey interbed	
				10.5	Elephant Mountain Member	basalt of Ward Gap basalt of Elephant Mountain Rattlesnake Ridge interbed	
				12.5	Pomona Member	basalt of Pomona Selah interbed	
					Esquarzel Member	basalt of Gable Mountain Cold Creek interbed	
				13.5	Asatin Member	basalt of Huntzinger	
					Wilbur Creek Member	basalt of Laowai basalt of Wahluke	
					Umatilla Member	basalt of Sillusi basalt of Umatilla	
				14.5	Priest Rapids Member	basalt of Lolo basalt of Rosalia Quincy interbed	
					Roza Member	basalt of Roza Squaw Creek interbed	
					Frenchman Springs Member	basalt of Lyons Ferry basalt of Sentinel Gao basalt of Sand Hallow basalt of Silver Falls basalt of Ginkgo basalt of Palouse Falls Vantage interbed	
			15.6	N ₂	Sentinel Bluffs Unit	basalt of Museum basalt of Rocky Coulee basalt of Levering basalt of Cohasset basalt of Birkett basalt of McCov Canyon	
			16.5			Umtanum Unit	basalt of Umtanum
						Stack Canyon Unit	
						Ortley Unit	basalt of Benson Ranch
			Grande Ronde Basalt*	R ₂	Grouse Creek Unit		
					Waoshita Ridge Unit		
					Mt. Horrible Unit		
					China Creek Unit		
					Teepee Butte Unit		
					Buckham Spring Unit		
17.5	Rock Creek Unit						
Imnaha		American Bar Unit					

Ellensburg Formation

*The Grande Ronde Basalt consists of at least 120 major basalt flows. Only a few flows have been named.

N₂, R₂ are magnetostratigraphic units.

SOURCE: DOE 1993b

Figure I.1.3.2 Stratigraphic Column for the Hanford Site Showing Nomenclature Previous Investigations

Newcomb 1958			Tallman et al. 1979			PSPL 1982			Bjomstad 1984			Lindsey et al. 1992			Thorne et al. 1993		
Alluvium			Alluvium Colluvium, & Eolian Sediments			Sand Dunes, Loess, Alluvium			Eolian Sediments, Alluvium, Colluvium			Holocene Surficial Deposits			Holocene Surficial Deposits		
Glaciofluvialite and Fluvialite Deposits			<div>Hanford Fm.<div>Pasco Gravels</div><div>Touchet Beds</div></div>			<div>Hanford Fm.<div>Pasco Gravels</div><div>Pre-Missoula</div></div>			<div>Hanford Fm.<div>Pasco Gravels</div><div>Touchet Beds</div></div>			<div>Hanford Fm.<div>Gravel Dominated</div><div>Laminated Sands</div><div>Graded Rhythmites</div></div>			<div>Hanford Fm.<div>Gravel Dominated</div><div>Laminated Sands</div><div>Graded Rhythmites</div></div>		
Ringold Fm.	Upper Unit		Early "Palouse" Soil			Unit IV			Early "Palouse" Soil			Pre-Missoula Gravels			Pre-Missoula Gravels		
			Upper Ringold						Plio-Pleistocene Unit			Upper Unit Ringold			Upper Fines Unit		
	Middle Unit		Middle Ringold			Unit III			Middle Ringold			Ringold Unit E			Upper Coarse Unit 5		
	Lower Unit		Lower Ringold			Unit II			Lower Ringold			Ringold Unit C			Middle Fines Unit 5		
			Basal Ringold			Unit I - Upper			Basal Ringold - Fine			Lower Mud Sequence			Middle Coarse Unit 7		
						Unit I - Basal			Basal Ringold - Coarse			Ringold Unit D			Lower Mud Unit 3		
												Ringold Unit A			Basal Coarse Unit 9		
												Paleosols					
Columbia R. Basalt Group			Columbia R. Basalt Group			Columbia R. Basalt Group			Columbia R. Basalt Group			Columbia R. Basalt Group			Columbia R. Basalt Group		
Saddle Mtns. Basalt			Saddle Mtns. Basalt			Saddle Mtns. Basalt			Saddle Mtns. Basalt			Saddle Mtns. Basalt			Saddle Mtns. Basalt		
Elephant Mountain Member			Elephant Mountain Member			Elephant Mountain Member			Elephant Mountain Member			Elephant Mountain Member			Elephant Mountain Member		
Rattlesnake Ridge Interbed			Rattlesnake Ridge Interbed			Rattlesnake Ridge Interbed			Rattlesnake Ridge Interbed			Rattlesnake Ridge Interbed			Rattlesnake Ridge Interbed		
Pomona Member			Pomona Member			Pomona Member			Pomona Member			Pomona Member			Pomona Member		

SOURCE: Schramke et al. 1994

northern and northeastern parts of the 200 East Area and adjacent areas to the north (Delaney et al. 1991, Reidel et al. 1992, and Cushing 1994).

Five sediment facies (or differentiation) associations, defined on the basis of lithology, stratification, and pedogenic (formation and development of soil) alteration, are recognized in the Ringold Formation (Delaney et al. 1991). These sediment facies include:

- Fluvial (produced by action of a stream) gravel deposited in wide-shifting river channels,
- Fluvial sand deposited in shallow channels incised into a muddy floodplain,
- Overbank-paleosol deposits that record deposition on a floodplain,
- Lacustrine (in-lake) deposits that record deposition in a lake, and
- Alluvial fan deposits that record deposition of basaltic detritus around the periphery of the Pasco Basin.

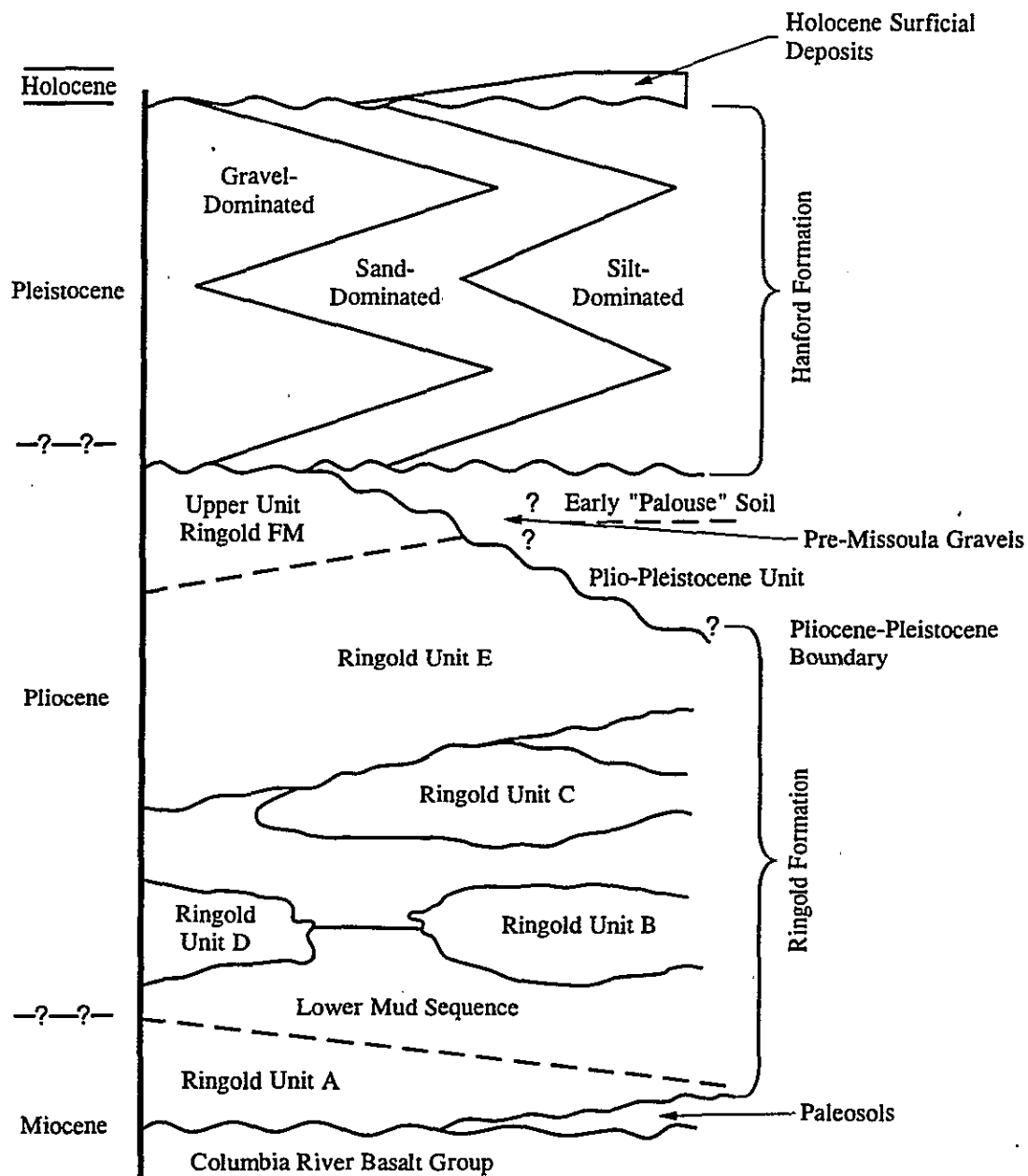
The distribution of facies associations within the Ringold Formation forms the basis for stratigraphic subdivision of the formation (Lindsey 1991). The lower half of the Ringold Formation contains five separate stratigraphic intervals dominated by fluvial gravels. These gravels, designated Units A, B, C, D, and E, are separated by intervals containing deposits typical of the overbank-paleosol and lacustrine facies associations (Delaney et al. 1991). The lowermost of the fine-grained sequences overlying Unit A is designated the lower mud sequence. The uppermost gravel unit, Unit E, grades upward into interbedded fluvial sand and overbank deposits that are in turn overlain by lacustrine-dominated strata.

The lower mud sequence (Figure I.1.3.3) consists of overbank and lacustrine deposits and is substantial hydrologically in that it is a potential confining layer that may offer some hydraulic separation between the saturated Ringold Formation above and the underlying Unit A gravels. The lower mud sequence is generally absent in the northern part of the 200 East Area and at the main lobe of B Pond (Trent 1992b). In the 200 West Area, the lower mud sequence is generally present throughout, except in the northeast corner (Trent 1992a). In the 200 West Area, the thickness of the lower mud sequence ranges from over 30 m [100 ft] in the south-central portion of the area to being nonexistent in the northeast corner.

I.1.3.5 Post-Ringold and Pre-Hanford Units

Thin, laterally discontinuous alluvial deposits separate the Ringold Formation from the Hanford Formation in various parts of the Hanford Site. These deposits are referred to informally as the Plio-Pleistocene unit, pre-Missoula gravels, and early Palouse soil (Figure I.1.3.3). The Plio-Pleistocene unit unconformably overlies the Ringold Formation in the western Cold Creek syncline in the vicinity of the 200 West Area. Depending on location, two types of materials may be present within the Plio-Pleistocene unit consisting of interfingering carbonate-cemented silt, locally referred to as "caliche layer" (Trent 1992a), sand and gravel, carbonate-poor silt and sand, and/or

Figure I.1.3.3 General Stratigraphy of the Suprabasalt Sediments of the Hanford Site



SOURCE: Lindsey 1992

basaltic detritus consisting of weathered and unweathered basaltic gravels deposited as locally derived slope wash, colluvium, and sidestream alluvium.

Pre-Missoula gravels are composed of quartzose to gneissic pebble to cobble gravel with a sand matrix. These gravels are up to 25 m (82 ft) thick, contain less basalt than underlying Ringold gravels and overlying Hanford deposits, have a distinctive white or bleached color, and sharply truncate underlying strata. The early Palouse soil consists of up to 20 m (66 ft) of silt and fine-grained sand. Deposits composing the early Palouse soil are massive, brownish-yellow, and compact.

I.1.3.6 Hanford Formation

The Hanford Formation consists of pebble to boulder gravel, fine to coarse grained sand, and silt. These deposits are divided into three facies; gravel-dominated, sand-dominated, and silt-dominated (Figure I.1.3.3). These facies are referred to as coarse-grained deposits, plane laminated sand facies, and rhythmite facies, respectively (Reidel et al. 1992). The rhythmites also are referred to as the Touchet Beds or slack water deposits. The Hanford Formation is thickest in the vicinity of the Central Plateau where it is up to 65 m (210 ft) thick. The Hanford Formation was deposited by cataclysmic flood waters that drained out of a glacial lake named Missoula. Hanford Site deposits are absent on ridges more than approximately 385 m (1,260 ft) above sea level, the highest level of cataclysmic flooding in the Pasco Basin (Reidel et al. 1992).

The sand-dominated facies was deposited adjacent to the main flood channelways and is found most commonly in the central Cold Creek syncline in the central to southern parts of the Central Plateau and in the vicinity of the Washington Public Power Supply System facilities. The silty facies was deposited under slack water conditions in back-flooded areas and is found throughout the central, southern, and western Cold Creek syncline within and south of the Central Plateau.

I.1.3.7 Holocene Surficial Deposits

Holocene surficial deposits consist of silt, sand, and gravel that form a thin (less than 10 m [30 ft]) veneer across much of the Hanford Site. These sediments were deposited by a mix of eolian (wind) and alluvial processes.

I.1.4 MINERAL RESOURCES

The geology of the potential Vernita Quarry and McGee Ranch borrow sites contains successions of basalts flows and suprabasalt sediments similar to those found on the Central Plateau and the areas near these sites along the Columbia River. The Vernita Quarry site is located in the Umatilla flow of the Saddle Mountain basalt. The Umatilla Flow at this location is composed of a single collonade characterized by columns 0.9 m to 1.2 m (3.0 ft to 4.0 ft) wide. A bench approximately 12 m to 15 m (40 ft to 50 ft) thick exists at the current quarry site and extends eastward as part of a series of benches that correspond to erode basalt flows along the valley of the Columbia River. The Pomona flow overlies the Umatilla flow and crops out approximately 300 m (1,000 ft) east of the existing quarry. The Pomona flow locally comprises a single colonnade with columns generally less than 0.6 m (2.0 ft) wide (Duranceau 1995).

At the potential McGee Ranch borrow site, a geological evaluation revealed a layer of fine-grained sediments immediately below the surface that range in thickness from 0.5 m to 10.0 m (1.5 ft to 33 ft) thick. A layer of silty, sandy gravel was identified directly beneath the surficial layer of fine-grained sediments. Hanford Formation sediments overlay the Plio-Pleistocene unit and range in thickness from 0.15 m to 12 m (0.5 ft to 40 ft). The ground surface at McGee Ranch is covered with pebbles, some cobble gravels and occasional boulders (DOE 1994h).

Currently no mineral resources other than crushed rock, sand, and gravel are produced from the Pasco Basin. Deep, natural gas production from anticlines in the basalt has been tested by oil exploration companies without commercial success. There are no current indications of any commercial mineral resource potential at any of the TWRS sites.

I.1.5 GEOLOGIC HAZARDS

Geologic processes that alter topography are landslides, floods, and volcanic activity. Each of these processes are briefly discussed in the following text as they relate to proposed TWRS activities.

I.1.5.1 Landslides

Landslides in the Ringold Formation sediments are common in areas where these sediments have been oversteepened by erosion, such as the White Bluffs area along the Columbia River. The likelihood of such oversteepening in the TWRS site areas is extremely low because of flat topography, a deep water table, and the absence of any actively eroding streams.

I.1.5.2 Floods

The nearest potential flooding source to the TWRS sites is Cold Creek. Studies of the probable maximum flood show that its effect is limited to the southwestern corner of the 200 West Area only (Cushing 1994). Because of the distance from the river, the probable maximum flood on the Columbia River would not impact the 200 Areas or any of the potential borrow sites. Failure of the upstream dams, either because of natural causes or sabotage, would not likely impact the 200 Areas or the potential borrow sites (Cushing 1994).

I.1.5.3 Volcanic Activity

Two types of volcanic activity have impacted the Pasco Basin in the past, basaltic flood volcanism and cascade-style diacitic volcanism to the west. The basaltic volcanism has been latent for the past eight million years and appears unlikely to resume because of changes in the plate tectonic regime of the region. The only source of volcanic activity that could impact the TWRS sites would be volcanism in the Cascade Mountain Range, more than 100 km (60 mi) west of the Hanford Site. The eruption of Mount St. Helens in 1980 is an example of such a volcanic event. This eruption caused considerable ashfall at the Hanford Site.

I.1.6 SEISMICITY

Seismicity at the Hanford Site is dominated by the position of the Site within the back-arc terrane of the Cascadia Subduction Zone formed where the Juan de Fuca Plate slides underneath the North American Plate (DOE 1995i). The back arc terrane of Washington occurs east of the Cascade Mountains, and is underlain primarily by Jurassic to early Miocene metamorphic and volcanic rocks, which represent the accreted terrains of past collisions and continental deposits eroded from them (Reidel et al. 1989). Overlying a portion of this terrane is the Columbia Basalt Plateau, a region of thick tholeiitic basalt lava flows. The Hanford Site and proposed project sites lie within a subprovince of this basalt province known as the Yakima Fold Belt (RHO 1979).

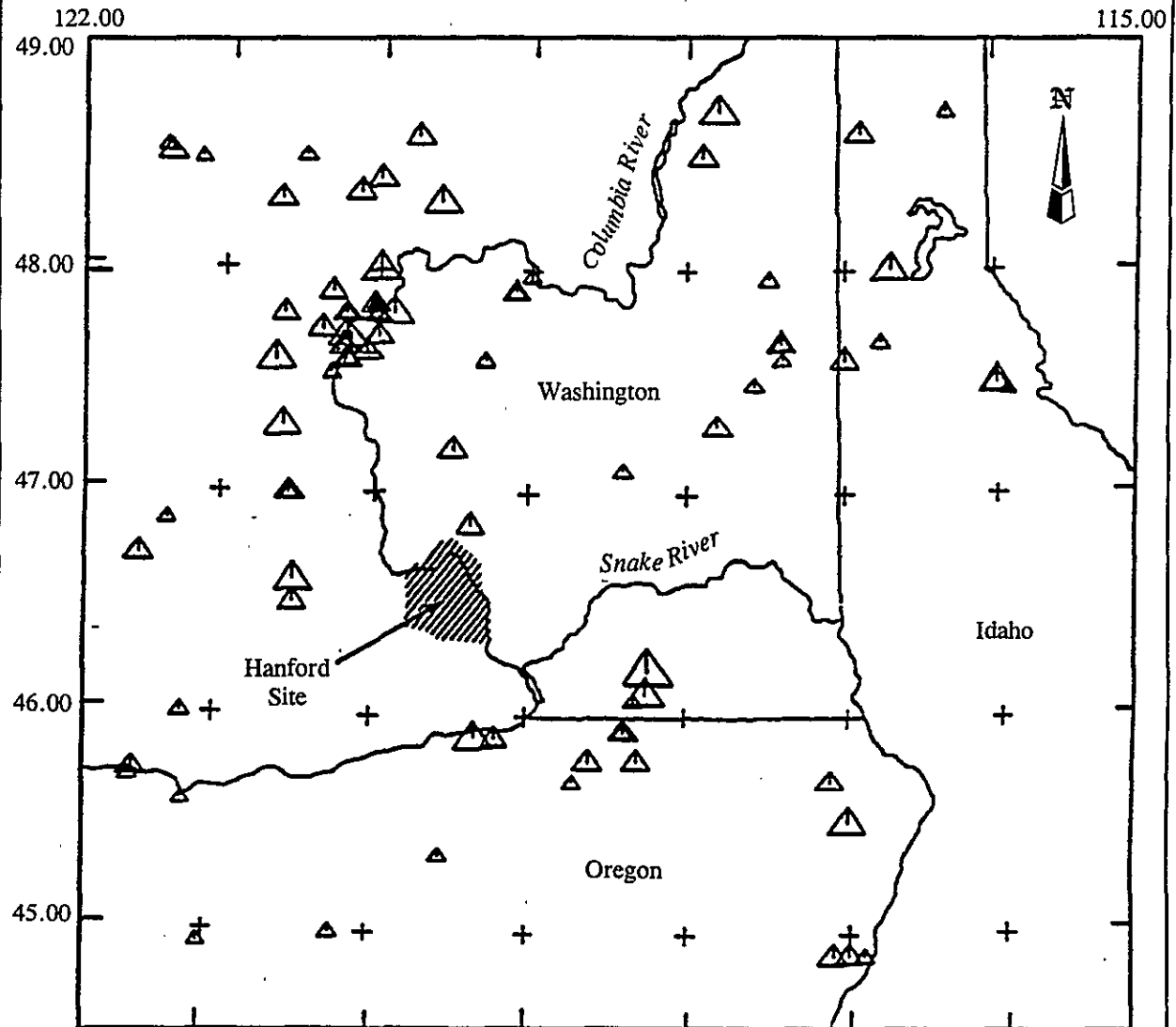
The Yakima Fold Belt is characterized by narrow, linear anticlinal ridges of basalt and broad synclinal basins with an east to east southeast orientation. The folds have wave lengths of between 5 and 32 km (3 and 20 mi), amplitudes of less than 1 km (0.6 mi), and are commonly steeper on the northern limb. The faults in the subprovince appear to be associated with the folding and are found on the flanks of the folds. The folds extend eastward up to 113 km (70 mi) from the Cascade Range Province and were growing during the eruption and emplacement of the basalt and probably continue to grow at the present time (DOE 1988). In general, the structures do not impact the sediments that overlie the basalt.

Sources of seismic activity (earthquakes) at the Hanford Site include shallow structures in the Yakima Fold Belt or Columbia River Basalts. The orientation of the structural fabric of the Yakima Fold Belt suggests an origin by north-south compressional forces that operated from the middle Miocene age to the present. Compression during the extrusion of the lavas resulted in the folds propagating upwards through succeeding flows, folding the latest flow, and faulting the underlying flows (Reidel et al. 1989). The Hooper and Convey Model (Reidel et al. 1989) suggests that the compressive stress is horizontal and transmits deformation in a brittle manner only in the Columbia River Basalts (Geomatrix 1993). It is believed that the underlying pre-basalt rocks deform in a ductile fashion and thus do not generate seismic activity. One of the most active areas of shallow earthquake activity is along the Saddle Mountain anticline, north of the Hanford Site (RHO 1979). Seismic activity within deep basement structures does not adequately explain the pattern of seismicity recorded in the region. The most recent seismic hazard analysis of the Hanford Site assumes that seismic activity occurs more or less randomly in the crust (Geomatrix 1993). The source of seismic activity in the region that could potentially impact the Hanford Site is the Cascadia Subduction Zone, which lies off the coast of the Pacific Northwest. Two separate sources of seismic activity exist within this zone: an intraplate source where seismic events occur within the subducted Juan de Fuca oceanic plate, and an interplate source where seismic events occur at the interface of the Juan de Fuca and the North American plates. Of the two, the interplate source has the highest probability of generating earthquakes of a magnitude capable of causing ground motion at the TWRS sites that could impact the proposed facilities (Geomatrix 1993).

I.1.6.1 Earthquake History

The Hanford Site lies in an area of relatively low seismic activity (Figures I.1.6.1. and I.1.6.2). Between 1870 and 1980 only five earthquakes have occurred in the Columbia Plateau region that had Mercalli Intensities (MMI) of VI or greater. All these events occurred prior to 1937. The largest

Figure I.1.6.1 Historical Seismicity of the Columbia Plateau and Surrounding Areas



All earthquakes between 1850 and 1969 with a Modified Mercalli Intensity of IV or larger with a magnitude of 3 or greater are shown.

LEGEND		
MMI		Equivalent Richter Magnitude (Calculated)
	IV	3.3 - 4.0
	V	4.0 - 4.7
	VI	4.7 - 5.3
	VIII	5.3 - 6.3

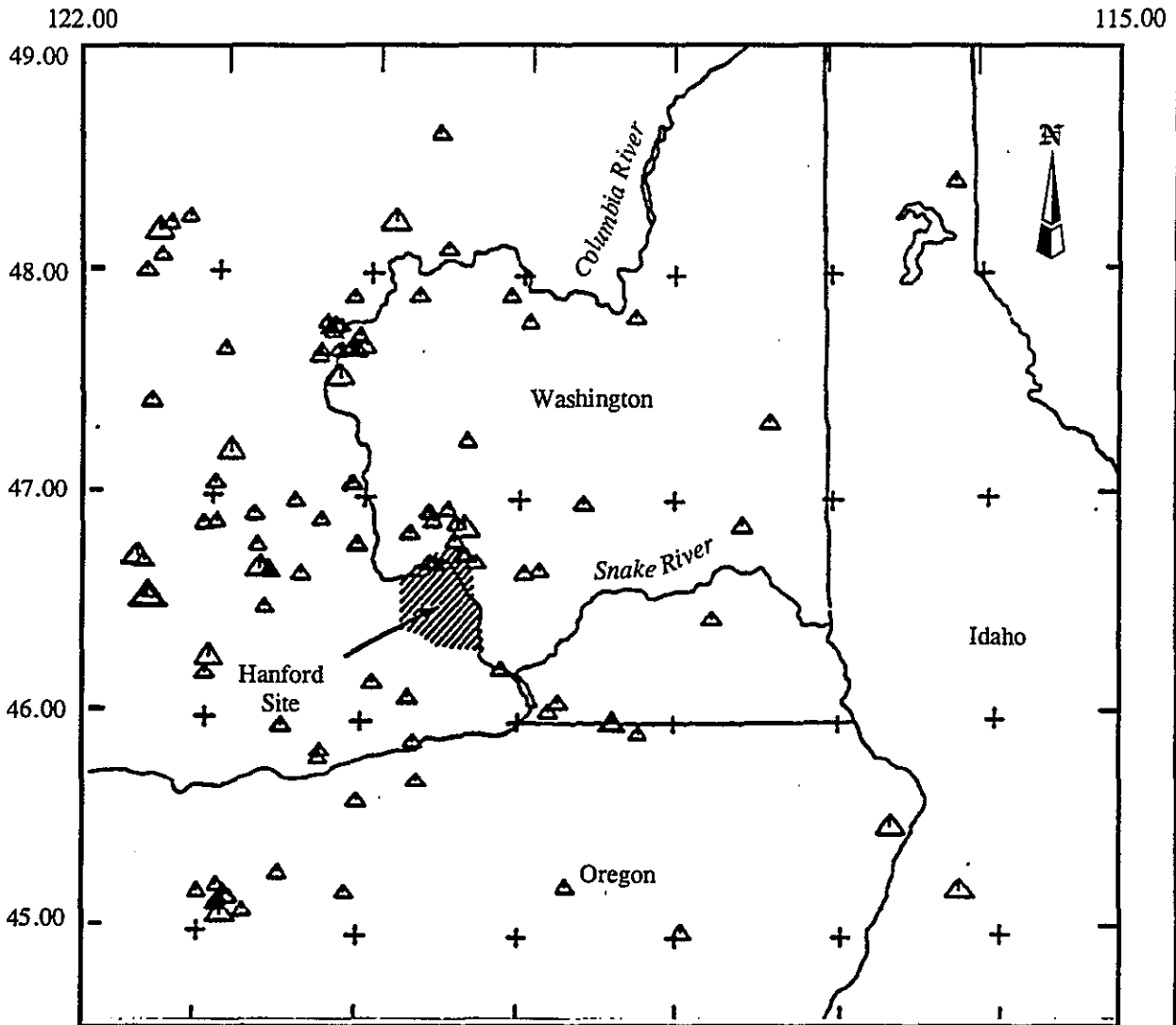
0 50 100 kilometers

0 25 50 miles

+ Latitude/Longitude Intersection

SOURCE: Cushing 1994

Figure I.1.6.2 Recent Seismicity of the Columbia Plateau and Surrounding Areas as Measured by Seismographs



All earthquakes between 1969 and 1986 with a Modified Mercalli Intensity of IV or larger with a magnitude of 3 or greater are shown.

LEGEND

Richter Magnitude
(Measured)

- ▲ 3.0 - 3.9
- ▲ 4.0 - 4.9
- ▲ 5.0

0 50 100 kilometers



0 25 50 miles

+ Latitude/Longitude Intersection

SOURCE: Cushing 1994

event was the July 16, 1936 Milton-Freewater, Oregon earthquake (MMI=VII; surface wave magnitude [M] = 5.8) (DOE 1988). The location of this earthquake and its association with known geologic structures are uncertain (DOE 1988).

Other earthquakes with a Richter magnitude of 5.0 or larger have occurred near Lake Chelan, Washington to the northwest, along the boundary of the Columbia Plateau and the Cascade Mountain range, west and north of the Hanford Site, and east of the Hanford Site in Washington State and northern Idaho. In addition, earthquake swarms of small magnitudes occur on and around the Hanford Site. An earthquake swarm is a series of earthquakes closely related in terms of time and space.

Seismicity with the Columbia Plateau can be segregated into three depth zones: 0 to 4 km (0 to 2.5 mi); 4 to 8 km (2.5 to 5 mi); and deeper than 8 km (5 mi). Approximately 70 to 80 percent of the seismic activity occurs in the 0 to 4 km (0 to 2.5 mi) zone, and 90 percent of it occurs in the first two zones (DOE 1988). Most of the earthquakes in the central Columbia plateau are north or northeast of the Columbia River. Most of the earthquakes in the shallowest zone occur as swarms, which are not associated with mapped faults.

I.1.6.2 Seismic Hazards

Three major structures of the Yakima Fold Belt are found within the Hanford Site: the Umtanum Ridge-Gable Mountain Structure, the Yakima Ridge Structure, and the Rattlesnake Hills Structure. Each is composed of an asymmetrical anticline over-steepened to the north and with associated faults along their flanks. Two types of faults associated with the folds have been identified. Thrust faults occur on the northern, over-steepened limbs of the folds. These folds are sympathetic to the folds with more or less the same strike as the fold axes. Cross faults with a north-northwest trend cut the linear folds into separate segments and show a right lateral strike-slip movement (Reidel et al. 1989). Existing known faults within the Hanford area include wrench (strike-slip) faults, as long as 3 km (1.9 mi) on Gable Mountain and the Rattlesnake-Wallula Alignment, which had been interpreted as a right-lateral strike-slip fault. The faults in Central Gable Mountain are considered capable faults by Nuclear Regulatory Commission (NRC) criteria in that they have slightly displaced the Hanford Formation gravels, but their relatively short lengths give them low seismic potential. No seismicity associated with the Gable Mountain Fault has been observed. The Rattlesnake-Wallula Alignment is interpreted to be capable faults by the NRC (Supply System 1981).

Earthquake sources considered relevant for the purpose of seismic design of TWRS facilities are the Rattlesnake-Wallula Alignment, Gable Mountain, an earthquake anywhere in the tectonic province, and the swarm area. For the Rattlesnake-Wallula Alignment, which passes along the southwest boundary of the Hanford Site, a maximum Richter magnitude of 6.5 has been estimated. For Gable Mountain, an east-west structure that passes through the northern portion of the Hanford Site, a maximum Richter magnitude of 5.0 was estimated. An earthquake for the tectonic province was developed from the Milton-Freewater earthquake of Richter magnitude 5.75. A Richter magnitude 4.0 event is considered a maximum swarm earthquake for analyzing TWRS alternatives, based on the maximum swarm earthquake in 1973 (Cushing 1994).

I.1.7 SOIL

The surface and near-surface soils in the 200 Areas are not generally well developed and consist of a number of soil types: Rupert sand, Burbank loamy sand, and Ephrata sandy loam. An additional soil unit, Hezel sand, is also present on the western boundary of the 200 West Area. Rupert sand consists of coarse sand and is also known as Quincy sand. The soil covers the majority of the 200 West Area and approximately one-half of the 200 East Area. Burbank sand is coarse-textured sand that covers approximately the northeastern one-third of the 200 West Area, a relatively small portion of the 200 East Area, and the majority of the area between the 200 West and 200 East Areas, where the potential Pit 30 borrow site (sand and gravel source) is located. Ephrata soil is medium-textured soil and covers the northern portion of the 200 East Area. Hezel sand is similar to Rupert sand and covers a portion of the area on and immediately west of the boundary of the 200 West Area. The predominant soil types in the general vicinity of the potential Vernita Quarry and McGee Ranch borrow sites are the Rupert sand and Burbank loamy sand.

I.1.7.1 Soil Contamination

Soil monitoring is conducted to detect the potential migration and deposition of radionuclides because of resuspension from other radioactive contaminated areas (wind-blown or water-borne) and waste intrusion by animals (PNL 1993a). The following contaminants were consistently detectable in soil on the Hanford Site: cobalt-60 (Co-60), strontium-90 (Sr-90), cesium-137 (Cs-137), plutonium-239 (Pu-239), plutonium-240 (Pu-240), and uranium (U). Soil concentrations for these radionuclides were higher near and within Hanford Site facilities compared to offsite concentrations. In general, radionuclide concentrations near waste disposal sites are higher than concentrations further away. Results from 1994 analyses of soil samples taken from the 200 Areas showed a downward trend for most radionuclides because of facility shutdowns and improved management practices (PNL 1995).

Radiological surveys are conducted on Site areas that are known or suspected to contain surface or subsurface contamination. Areas that exceed specified levels are posted as radiologically controlled areas. A total of nearly 2,800 hectares (ha) (6,400 acres [ac]) of surface area and 980 ha (2,400 ac) of subsurface area were posted at the end of 1994. Ninety percent of the posted surface contamination area and 81 percent of the posted subsurface contamination area are in and near the 200 Areas. Sitewide, the net change in posted contamination areas from 1993 to 1994 was a reduction of 49 ha (120 ac) in surface contamination areas, which includes a reduction of 35 ha (87 ac) in the 200 Areas. There was a net increase in posted subsurface contamination areas of 49 ha (120 ac) from 1993 to 1994, which includes an increase of 35 ha (87 ac) in the 200 Areas (PNL 1995).

I.2.0 WATER RESOURCES

Baseline conditions for water resources and hydrology encompass surface water, vadose zone, and groundwater, each of which may be impacted by implementing proposed TWRS activities.

I.2.1 SURFACE HYDROLOGY, INCLUDING FLOODPLAINS

The following subsections describe surface water resources, including the occurrence and characteristics of surface water, floodplains, and runoff.

I.2.1.1 Occurrence and Characteristics

West Lake and two small spring-fed streams in the Fitzner Eberhardt Arid Lands Ecology Reserve are the only naturally-occurring water bodies on the Hanford Site. West Lake is several hectares in size and is located approximately 8 km (5 mi) northeast of the 200 West Area and about 3 km (2 mi) north of the 200 East Area. It is situated in a topographically low-lying area and is sustained by groundwater inflow resulting from an intersection with the groundwater table. West Lake was considered to be an ephemeral lake before operations began at the Hanford Site, with water level fluctuations dependent on groundwater level fluctuations. However, because of recharge (primarily from B Ponds) that contains low-level waste processing and cooling water from B Plant, water levels in the lake have become more stable.

Rattlesnake Springs, located 10 km (6 mi) west of the 200 West Area, forms a small surface stream that flows for approximately 2.5 km (1.6 mi) before it disappears into the ground as a result of seepage and evapotranspiration. The stream's base flow is approximately 0.01 cubic meters per second (m^3/sec) (0.4 cubic feet per second [ft^3/sec]). Snively Springs is located to the west and at a higher elevation than Rattlesnake Springs. It flows to the west and off of the Hanford Site (Cushing 1994).

Two ephemeral creeks, Cold Creek and its tributary, Dry Creek, traverse the uplands of the Hanford Site south and southwest of the 200 Areas. These creeks drain southeasterly toward the horn of the Yakima River, located south of the Hanford Site. Surface runoff from the uplands in and west of the Site is minor. These ephemeral creeks are not sustained by groundwater baseflow during any part of the year because depth to groundwater is over 46 m (150 ft) near the intersection of these creeks.

The Columbia River is 16 to 24 km (10 to 15 mi) downgradient from the nearest TWRS site toward the east and approximately 11 km (7 mi) toward the north. The river forms the eastern boundary of the Hanford Site and comprises the base-level and receiving water for groundwater and surface water in the region.

I.2.1.2 Floodplains and Runoff

There are no floodplains in the 200 Areas. The potential Vernita Quarry and McGee Ranch borrow sites are also not within areas of high flood risk. Although floods in Cold Creek and Dry Creek have occurred historically, there have not been any observed flood events or evidence of flooding in these creeks that has reached the 200 Areas before infiltrating into permeable sediments. During periods of unusually rapid snowmelt or heavy rainfall, surface runoff extends beyond Rattlesnake Springs in the upper part of Dry Creek. However, this runoff quickly infiltrates into the alluvial sediments of Cold Creek Valley.

Natural runoff generated onsite or from offsite upgradient sources is not known to occur in the 200 Areas. Measurable runoff occurs during brief periods in two locations, Cold Creek Valley and Dry Creek Valley, which are west and southwest of the 200 West Area (Newcomb et al. 1972). This surface runoff either infiltrates into the valley floor or evaporates. The total amount of annual recharge to the unconfined aquifer from these areas is estimated to be 555,000 square meters (m^2) (5,971,800 square feet [ft^2]). This generally occurs east of the Hanford Site (Newcomb et al. 1972).

I.2.2 GROUNDWATER

Groundwater conditions in the 200 Areas are described in the following subsections in terms of the general hydrogeologic setting, vadose zone characteristics, aquifer characteristics, and groundwater flow. Groundwater conditions in the areas of the potential Vernita Quarry and McGee Ranch borrow sites are similar to those of the 200 Areas, although limited specific information is available.

Groundwater contamination and groundwater uses are discussed in Section I.2.3.

I.2.2.1 Hydrogeologic Setting

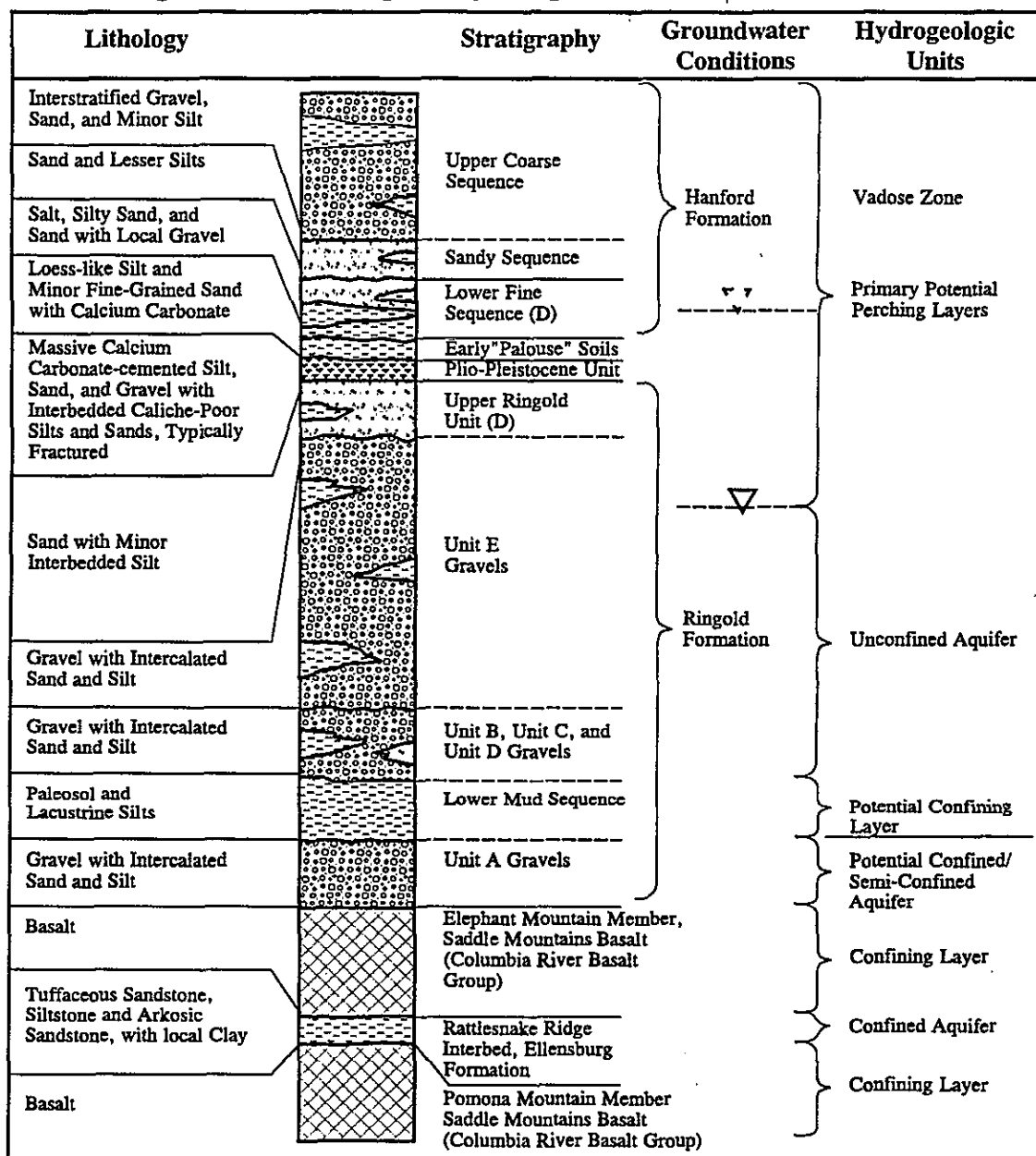
A thick vadose zone (approximately 70 m [200 ft] to over 90 m [300 ft] thick) as well as both confined and unconfined aquifers are present beneath the 200 Areas (DOE 1993a, 1993b). The vadose zone is over 90 m (300 ft) thick in the vicinity of the TWRS site in the 200 East Area (DOE 1993a).

The unconfined aquifer has not formally been named. This aquifer consists variably of the Ringold Formation (where present) and the lower portion of the Hanford Formation. The confined aquifers are found primarily within the Columbia River Basalts. The confined aquifers are not a major focus of this EIS because they are separated from the TWRS facilities by the vadose zone, unconfined aquifer (the focus of the groundwater modeling effort), and confining layer(s) and thus are not likely to be impacted. The conceptual hydrogeologic column for the Hanford Site is illustrated in Figure I.2.2.1. Figure I.2.2.2 is a generalized cross section through the 200 Areas showing the major geologic units and the relative position of the water table. The water table is generally at or near the interface between the Hanford and Ringold formations, as illustrated in both Figures I.2.2.1 and I.2.2.2.

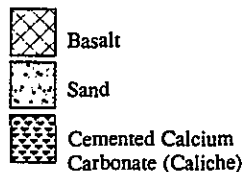
The occurrence and flow of groundwater in the unconfined aquifer must be described on a conceptual basis due to the difficulty of direct measurement. Five important concepts that describe flow in this aquifer are:

- 1) The numerous strata within the Ringold Formation, described in the previous section on stratigraphy, result in a much lower vertical hydraulic conductivity compared to the horizontal hydraulic conductivity. This results in a strong preference for groundwater to move horizontally.
- 2) Groundwater movement occurs mostly in the upper portion of the Ringold Formation. That is, most groundwater movement occurs in the sands and gravel that predominate in the upper portion of the Ringold Formation (Unit E Gravels).
- 3) The overbank deposits and the lower mud sequence near the base of the Ringold Formation act as confining layers, hydraulically separating the overlying unconfined aquifer from the confined aquifer.
- 4) Recharge to the unconfined aquifer is primarily from artificial sources (e.g., B Pond); groundwater inflow from the Dry Creek and Cold Creek synclines; and recharge from the Columbia River along the western reach of the horn of the Columbia River near N Reactor.
- 5) Discharge from the unconfined aquifer is primarily to the Columbia River from the top of the horn south of the Columbia River to the 300 Areas, and in the vicinity of the B and C Reactors. Groundwater discharge also occurs to West Lake.

Figure I.2.2.1 Conceptual Hydrologic Column for the Hanford Site



LEGEND



(D) Unit not Continuous

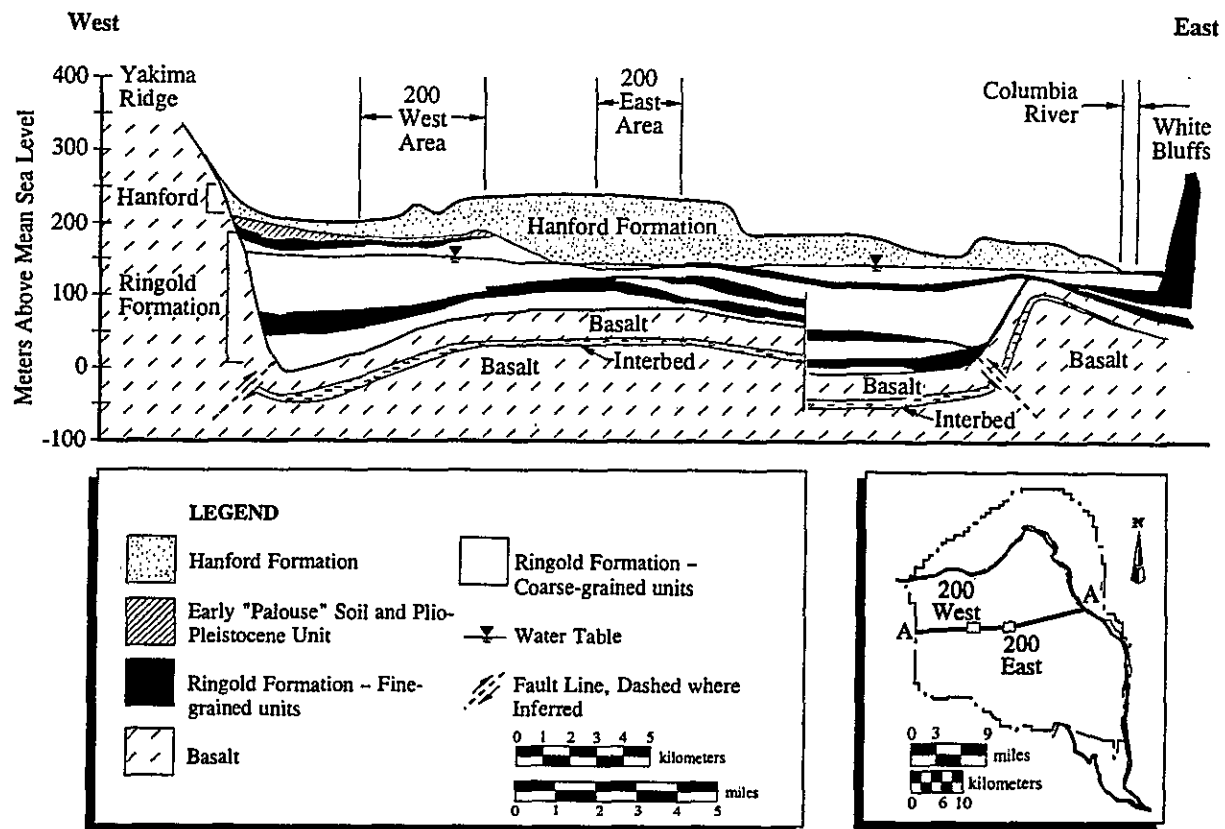


Groundwater Table

Potential Perching Layers
(Localized, potential perched groundwater may also be associated with fine-grained sediments of the Hanford Formation and upper Ringold unit)

SOURCE: Lithology, stratigraphy, and groundwater condition based on data from Lindsey 1992 and Delany et al. 1991.

Figure I.2.2.2 Geologic Cross Section of the Hanford Site



SOURCE: Adapted from PNL 1995

Natural recharge to the unconfined aquifer on the Hanford Site is extremely low and occurs primarily in the upland areas west of the Hanford Site. Artificial recharge from retention ponds and trenches contribute approximately 10 times more recharge than natural recharge. Seasonal water table fluctuations are not large because of the low natural recharge.

I.2.2.2 Vadose Zone

The vadose zone extends from the ground surface to the top of the saturated sediments of the unconfined aquifer. Vadose zone characteristics determine the rate, extent, and direction of liquid flow downward from the surface. This zone variably includes the Hanford Formation and locally includes the Ringold Formation Unit E Gravel. In the 200 West Area, the vadose zone is approximately 72 m (240 ft) thick (DOE 1993b). In the 200 East Area, the vadose zone is over 90 m (300 ft) thick, based on the 1991 depth to water level of the unconfined aquifer (DOE 1993a).

The following is a discussion of vadose zone characteristics such as infiltration, perched water, and soil moisture. Vadose zone environmental monitoring is also discussed.

I.2.2.2.1 Infiltration

The thick vadose zone, combined with the general aridity of the climate in the area, result in natural infiltration ranging from near zero (below detection) to around 11 centimeters per year (cm/yr) (4.3 inches [in.]/yr) (Gee et al. 1992). Some episodic recharge of groundwater may occur following periods of high precipitation, especially if combined with topographic depressions, highly permeable surface deposits such as gravel, and where the land is denuded of vegetation. Also, present conditions (bare ground and coarse sand and gravel surfaces) within the tank farms are conducive to higher infiltration than would be expected on undisturbed ground within the 200 Areas. For such conditions, infiltration near the upper range of 10 cm/yr (4.0 in./yr) would not be unreasonable. These however, are relatively recent changes occurring after 1940, and would not necessarily be expected to have altered the flow within the vadose zone for its full thickness.

The total natural recharge in the 200 West Area is estimated to be approximately $1.3\text{E}+8$ liters (L) (34 million gallons [gal]) per year (DOE 1993b). This is based on a average recharge rate of 0.1 cm/yr (0.04 in./yr) through fine-textured soil with deep-rooted vegetation. This value is approximately 10 times lower than recharge volumes from artificial sources.

The current principal sources of artificial recharge in the 200 West Area are four cribs and one ditch associated with the Uranium Oxide Plant (U Plant) area, located in the eastern portion of the 200 West Area (DOE 1993b). There are also four septic tanks and drain fields that actively discharge water to the soil. The combined volume discharge from these drain fields is estimated to be 12,000 L/day (3,200 gal/day). The total wastewater discharged from these facilities from 1944 to 1992, including the U Plant cribs and ditches, is estimated to have been $2\text{E}+11$ L (44 billion gal). T Plant and S Plant operations also resulted in large volumes of wastewater discharged to the soil. Liquid is no longer discharged to the soil column from U, T, or S Plants.

Natural recharge in the 200 East Area is estimated to be approximately $2\text{E}+7$ L (5 million gal) (DOE 1993a). This is based on a similar average natural recharge rate through fine-textured soil with deep-rooted vegetation, as noted previously for the 200 West Area. Artificial recharge in the 200 East Area is associated with approximately 140 ponds, trenches, cribs, and drains that were used to dispose of approximately $1\text{E}+12$ L (300 billion gal) of wastewater. The wastewater, except for limited discharges to the B Pond, is not directly discharged to the ground. The wastewater is treated at the facilities to meet the State groundwater standards and piped to a common discharge location in the 200 Areas for discharge to the soil column. The remaining discharges to the ground at B Pond will be rerouted to the central discharge location in 1997. Currently, there are 11 active waste management units and 20 active drain fields. These waste management units are associated with B Plant and the Plutonium-Uranium Extraction (PUREX) Plant and are located east and northeast of the TWRS site (DOE 1993a). The primary recipients of the wastewater were the ponds and trenches associated with B Plant and PUREX Plant; the 216-A-25 and B-3 Ponds received approximately $5\text{E}+11$ L (210 billion gal). Liquid is no longer discharged to the soil column from B Plant or the PUREX Plant.

Wastewater, such as the condensate removed from tank waste by the 242-A Evaporator, which is located in the eastern portion of the 200 East Area, is transferred by pipeline to the Effluent Treatment Facility, also located in the 200 East Area. The treated effluent from the Effluent Treatment Facility is then transferred by pipeline and discharged to the ground at the State-approved land disposal site located north of the 200 West Area. The treated wastewater meets all State groundwater discharge requirements except for tritium. The water is disposed of at this location further to the west so that the tritium contamination will decay to below drinking water standards in the groundwater before it reaches the Columbia River.

I.2.2.2.2 Perched Water

Perched water may occur within the vadose zone in the 200 West Area upon the caliche layer, approximately 55 m (180 ft) beneath the ground surface (DOE 1993b). Measured hydraulic conductivities of this unit range from 0.0009 to 0.09 m/day (0.003 to 0.3 ft/day). Caliche layers do not occur in the 200 East Area, and perched groundwater generally is not expected except in localized areas (Hoffman et al. 1992). Perched water has been reported in the vicinity of B Pond within the lower part of the Hanford Formation.

I.2.2.2.3 Soil Moisture

In areas where artificial recharge is occurring from ponds and trenches, soil is expected to be close to saturation, and would not likely be capable of holding substantial amounts of additional liquid. In addition, groundwater mounds have developed beneath these recharge areas. Where there is no artificial recharge, soil in the 200 Areas has a large moisture holding capacity (DOE 1992a).

I.2.2.2.4 Vadose Zone Contamination

Contaminants in the vadose zone in the 200 Areas are believed to be associated primarily with waste disposal practices that use engineered structures such as cribs, drains, septic tanks and associated drain fields, and reverse wells (that do not penetrate to the groundwater); percolation from ponds, ditches, and trenches such as B Pond and U Pond; and unplanned releases such as leaks from single-shell tanks (SSTs). The vadose zone is expected to be impacted by these past (and in some cases ongoing) waste management practices in the area immediately beneath the discharging facility and in an undetermined adjacent area (due to spreading as liquid percolates downward). Most Hanford Site environmental investigations have focused on the potential impacts of contaminants to the groundwater, not the vadose zone. Vadose zone investigations have often relied on geophysical gamma logs that are semiquantitative. The types of contaminants potentially present in the vadose zone near planned and unplanned release sites can be inferred by contaminants detected in the underlying groundwater, contaminants that are reported in waste disposal inventories, or from the Track Radioactive Component (TRAC) inventory system used for SSTs that may be leaking. Table I.2.2.1 lists these contaminants, which include both radioactive materials (transuranic isotopes, U, and fission products) and nonradioactive materials (metals, volatile organics, semivolatile organics, and inorganics).

Table I.2.2.1 Isotopes, Metals, and Organic Chemicals of Potential Concern at the 200 Areas

Transuranic Isotopes Americium-241 Americium-242 Americium-243 Barium-244 Barium-245 Neptunium-237 Neptunium-239 Plutonium-238 Plutonium-239 Plutonium-240 Plutonium-241	Radium-223 Radium-225 Radium-226 Radium-228 Radon-22 Rhodium-106 Ruthenium-106 Samarium-151 Selenium-79 Strontium-90 Technetium-99 Thallium-207 Thorium-227 Thorium-229 Thorium-230 Thorium-231 Thorium-232 Thorium-234 Tritium Yttrium-90 Zirconium-93	** 1,1,1-Trichloroethane ** 1,1,2-Trichloroethane Trichloroethylene ** Trichloromonofluoromethane Hexone (MIBK) * Tributyl phosphate * Xylenes
Uranium Isotopes Uranium-233 Uranium-234 Uranium-235 Uranium-236 Uranium-238	* Thorium-232	Semivolatile Organic Compounds Aldrin gamma-BHC * Bisphenol A Bis(2-ethylhexyl) phthalate Butyl phosphate ** p-Chloro-m-cresol * Cresols 2-Chlorophenol DDD DDT Dibutyl Phosphate 2,4-Dichlorophenol Dieldrin Dimethoate 2,4-Dimethylphenol ** 2,4-Dinitrophenol ** 2,4-Dinitrotoluene Endrin Heptachlor ** Hydrazine * n-Nitrodimethylamine Pentachlorophenol Phenol Pyrene ** 1,2-Propanedial ** 2,3,4,5-Tetrachlorophenol ** 2,4,5-Trichlorophenol ** Tributyl phosphate
Fission Products and Other Radioisotopes Actinium-225 Actinium-227 Antimony-125 Antimony-126 Antimony-126m * Barium-133 Barium-137m Bismuth-210 Bismuth-211 Bismuth-213 Bismuth-214 Carbon-14 Cesium-134 Cesium-135 Cesium-137 Cobalt-60 Europium-154 Europium-155 Francium-221 Iodine-129 * Krypton-85 Lead-209 Lead-210 Lead-211 Lead-214 * Nickel-59 Nickel-63 Niobium-93 Polonium-210 Polonium-214 Polonium-218 Potassium-40 ** Promethium-147 Protactinium-231	Metals ** Antimony Barium Beryllium Cadmium Chromium Copper Lead Manganese Mercury Nickel Silver ** Thallium ** Titanium Uranium Vanadium Zinc Volatile Organic Compounds * Acetone Carbon disulfide Carbon tetrachloride Chloroform ** Cyclohexanone 1,1-Dichloroethane 1,2-Dichloroethane ** cis-1,2-Dichloroethene ** trans-1,2-Dichloroethane Methylene chloride ** Methyl ethyl ketone (MEK) ** Methyl isobutyl ketone Hexone (MIBK) ** Styrene Tetrachloroethylene Toluene	Other Organic Compounds ** Ammonia Ammonium carbonate Ammonium nitrate Arsenic Boron Cyanide Ferrocyanide Fluoride ** Hydrofluoric acid Nitrate Nitrite ** Nitric acid ** Selenium ** Sodium dichromate * Sulfuric acid

Notes:

Modified from DOE 1993a and DOE 1993b

* 200 West Area Only

** 200 East Area Only

1.2.2.3 Aquifer Characterization

Groundwater of the unconfined aquifer is found throughout the Hanford Site in the suprabasalt sediments and locally includes the Rattlesnake Ridge Interbed in the area north of 200 East, where erosion has removed a portion of the basalt sequence (Trent 1992b). The relationship between the various stratigraphic units and the hydrogeologic units is shown in Figure I.2.2.1.

1.2.2.3.1 200 West Area

In the 200 West Area, the water table begins approximately 70 m (230 ft) beneath the surface. The saturated section, considered to be the unconfined aquifer, is composed of Ringold Formation Units A, B, C, D, and E gravels and is approximately 110 m (350 ft) thick above the Elephant Mountain member of the basalt. Hydraulic conductivities measured in the 200 West Area in the Ringold Unit E aquifer range from approximately 0.02 to 60 m/day (0.06 to 200 ft/day). Hydraulic conductivities range from 0.5 to 1.2 m/day (1.6 to 4 ft/day) in the semiconfined to confined Ringold Unit A Gravels (DOE 1993b). A discontinuous layer of silt and sand cemented by calcium-carbonate (caliche Plio-Pleistocene Unit), with a thickness up to 9 m (30 ft), occurs locally nearly 55 m (180 ft) in depth in the 200 West Area. This unit is believed to be responsible for perched water conditions in the vicinity of the TWRS sites in the 200 West Area.

1.2.2.3.2 200 East Area

Depth to groundwater in the 200 East Area ranges from 97 m (320 ft) in the southeast to 37 m (120 ft) in the vicinity of the 216-B-3C Pond (B Pond mound) located approximately 5 km (3 mi) east of the TWRS sites (DOE 1993a). The unconfined aquifer occurs within the Hanford and Ringold Formations. Groundwater near the TWRS sites occurs under unconfined conditions within the Ringold, approximately 96 m (315 ft) deep. The saturated (groundwater) section is approximately 34 m (110 ft) thick. Erosional windows occur in the basalt several kilometers north of the 200 East Area that allow some interconnection between the regionally confined Rattlesnake Ridge Interbed of the Ellensburg Formation in the basalt and the unconfined aquifer of the Hanford and Ringold Formations. Hydraulic conductivities of the unconfined aquifer near the TWRS sites in the 200 East Area range from 150 to 300 m/day (500 to 1,000 ft/day) (DOE 1993a).

1.2.2.4 Groundwater Flow

This section describes the physical characteristics of groundwater flow in the 200 Areas.

1.2.2.4.1 200 West Area

Figure I.2.2.3 is a contour map that shows depth to groundwater for the Hanford Site. Groundwater generally flows from west to east, with some localized exceptions. In the northwest corner of the 200 West Area, groundwater flow is to the north. Also, it appears that flow from the 200 West Area may bifurcate east of the Gable Butte subcrop, with a lesser flow component north toward the gap between Gable Butte and Gable Mountain and the remaining flow east toward the Columbia River (Kasza 1994).

These groundwater movement patterns are also indicated by the 1994 distribution of tritium (^3H) and nitrate (NO_3) in the unconfined aquifer, as shown on Figures I.2.2.4 and I.2.2.5, respectively. A north or northwest groundwater flow direction may also be indicated by the NO_3 distribution in the area north and west of the 200 West Area. Because of the contrast in hydraulic conductivity, most basalt subcrops and outcrops appear as impermeable compared to groundwater flow in the transmissive Hanford and Ringold Formations.

The tank farms in the 200 West Area are located above a groundwater mound caused by artificial recharge from the U Plant area, especially the 216-U-10 Pond. Groundwater elevations have declined greatly since the 216-U-10 Pond was decommissioned in the fall of 1984. Large declines in groundwater elevations have been recorded in seven wells in the U Plant area since 1984. Hydrographs of two wells (299-W19-1 and 299-W19-10) west of the tank farms indicate that groundwater elevations have declined approximately 5 m (15 ft) since the 216-U-10 Pond was decommissioned. The mound seems to have shifted slightly as it continues to dissipate beneath the 216-U-10 Pond toward the northeast beneath the 216-U-14 Ditch and 216-Z-20 Crib (DOE 1993b).

I.2.2.4.2 200 East Area

Groundwater flow in much of the 200 East Area is characterized by relatively low hydraulic gradients, ranging from 0.01 to 0.02 m/day (0.3 to 0.6 ft/day) (Kasza 1994). As shown in Figure I.2.2.3, water table elevations in the uppermost aquifer generally decrease from the margins of the Yakima Ridge in the west to the Columbia River in the east. There is a strong relationship between the water table as shown in Figure I.2.2.3 and the distribution of tritium in the uppermost aquifer as shown in Figure I.2.2.4. Both figures indicate that groundwater flow in the vicinity of the TWRS sites in the 200 East Area is toward the southeast.

Iodine-129 is an unretarded contaminant (i.e., it moves with groundwater at the average groundwater velocity), as are nitrate and tritium. The distribution of iodine-129 in the unconfined aquifer (Figure I.2.2.6) also shows a southeasterly groundwater flow direction. The iodine-129 plume is much smaller than the plumes associated with nitrate and tritium, probably because iodine-129 sources are not as ubiquitous in the unconfined aquifer.

The mound resulting from discharge from the 216-B-3 Pond is a notable perturbation to the easterly flow direction. B Pond is approximately 5 km (3 mi) east of the TWRS sites. Near the western portion of the mound, the groundwater gradient has been reversed in a west direction. The magnitude of this gradient direction reversal is currently diminishing as the mound decays. The groundwater gradient in the southeastern portion of the 200 East Area is expected to resume a more east trend as the decay continues (Kasza 1994).

I.2.2.4.3 Vertical Gradients

Vertical hydraulic gradients in the unconfined aquifer are estimated from water measurements in wells that are near to each other (sometimes referred to as well pairs) and have their sensing zones (screened intervals) completed at different elevations within the unconfined aquifer. In both the 200 East and

Figure I.2.2.3 Depth to Groundwater Contour Map of the Hanford Site

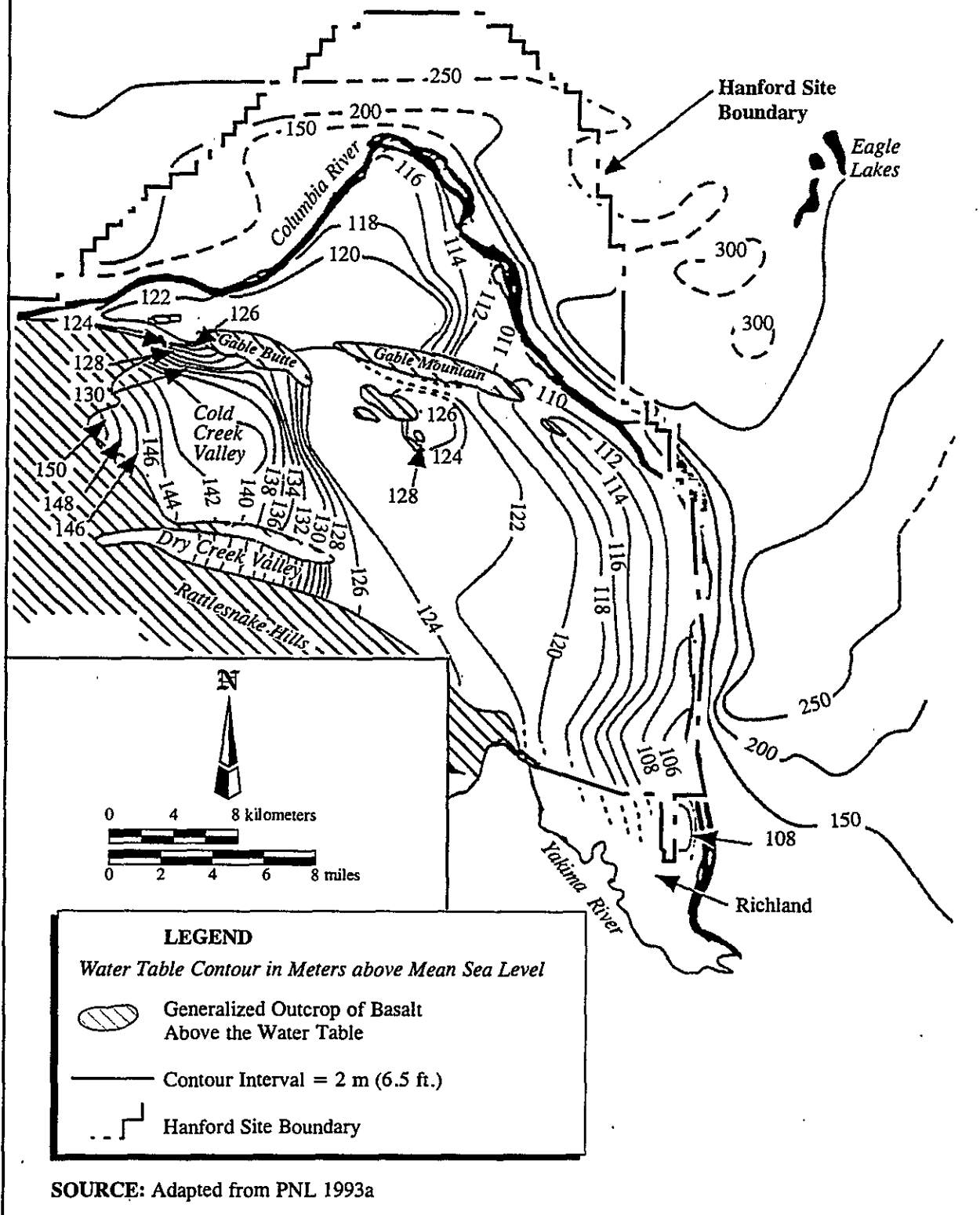


Figure I.2.2.4 Distribution of Tritium in the Unconfined Aquifer, 1994

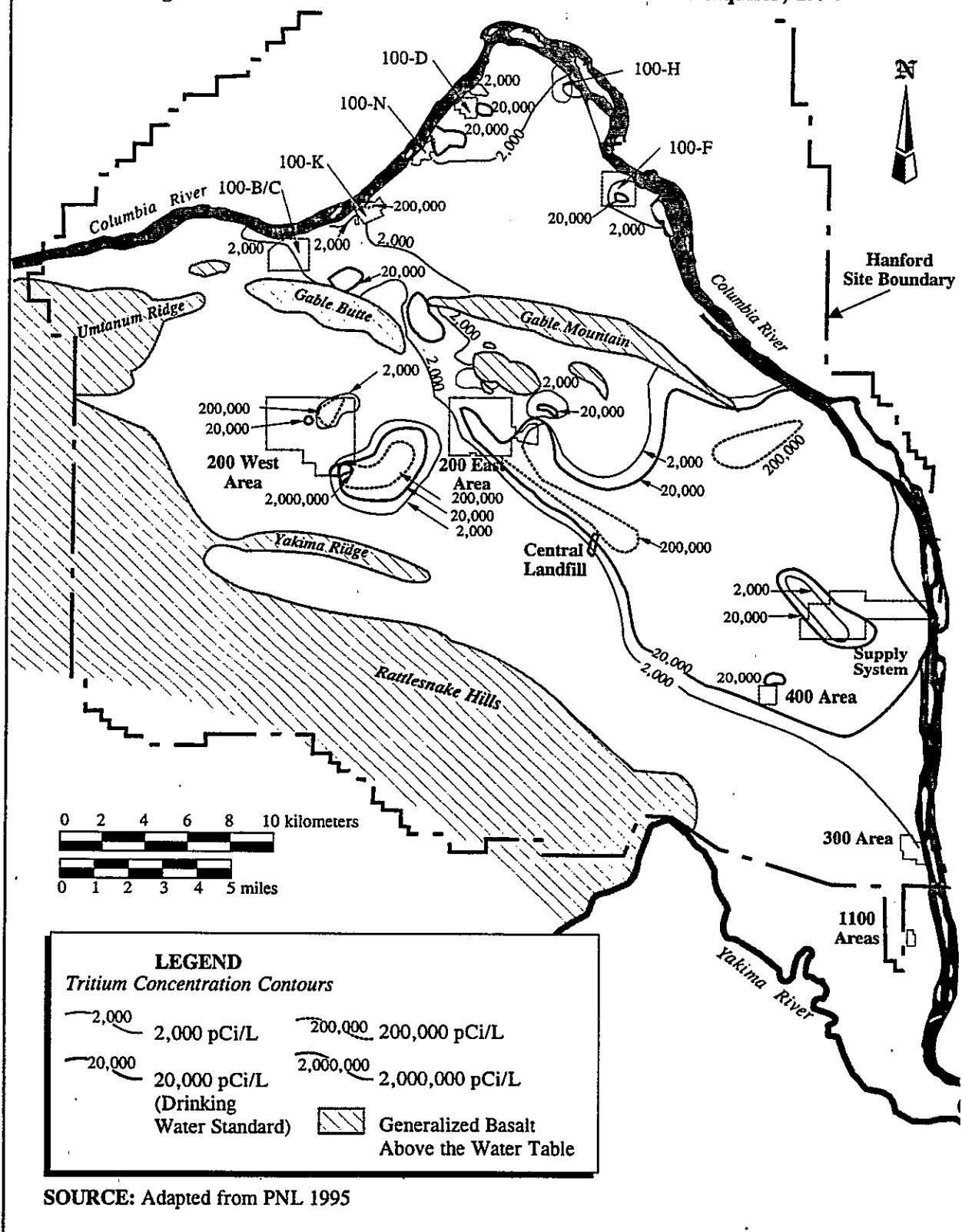
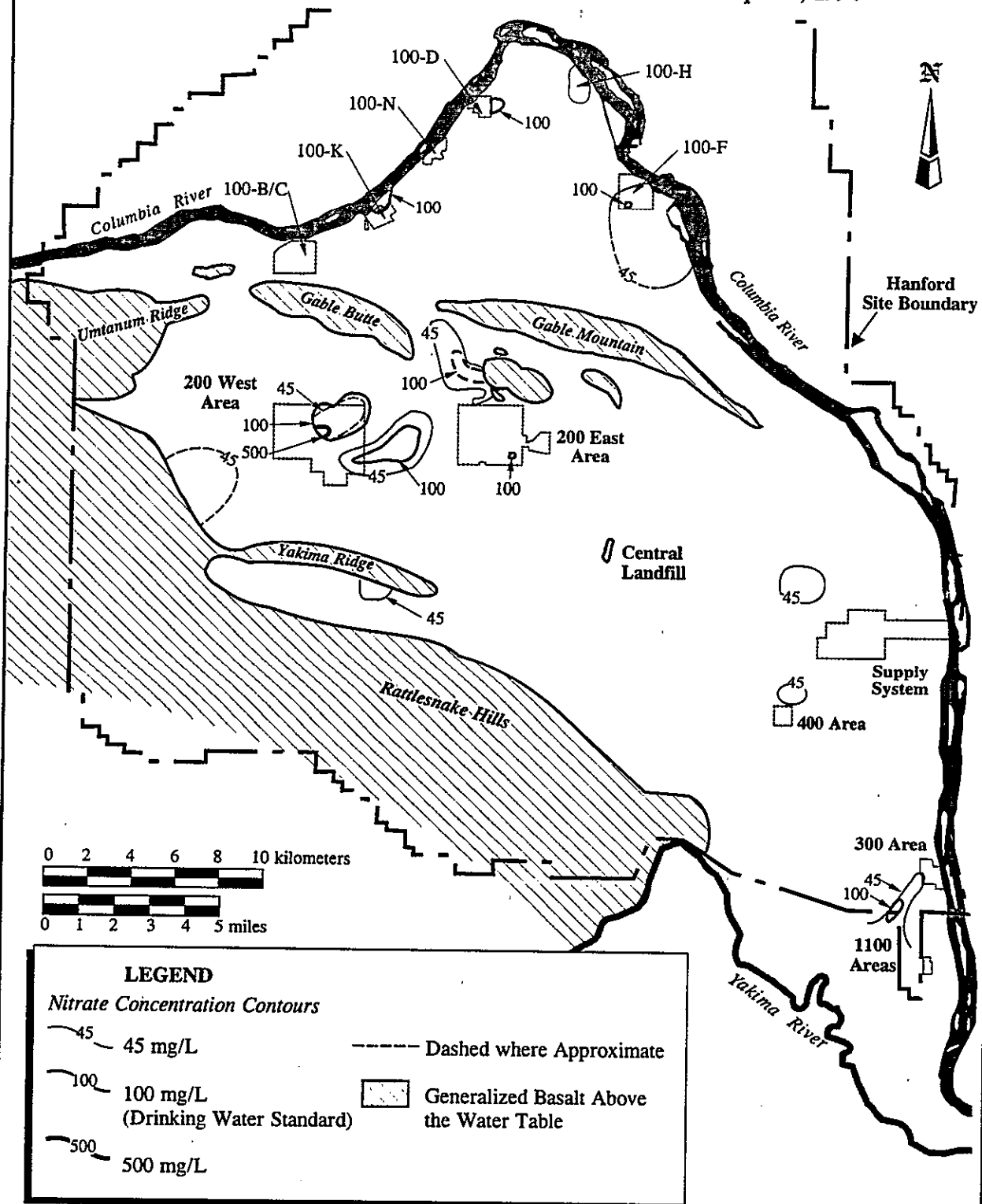
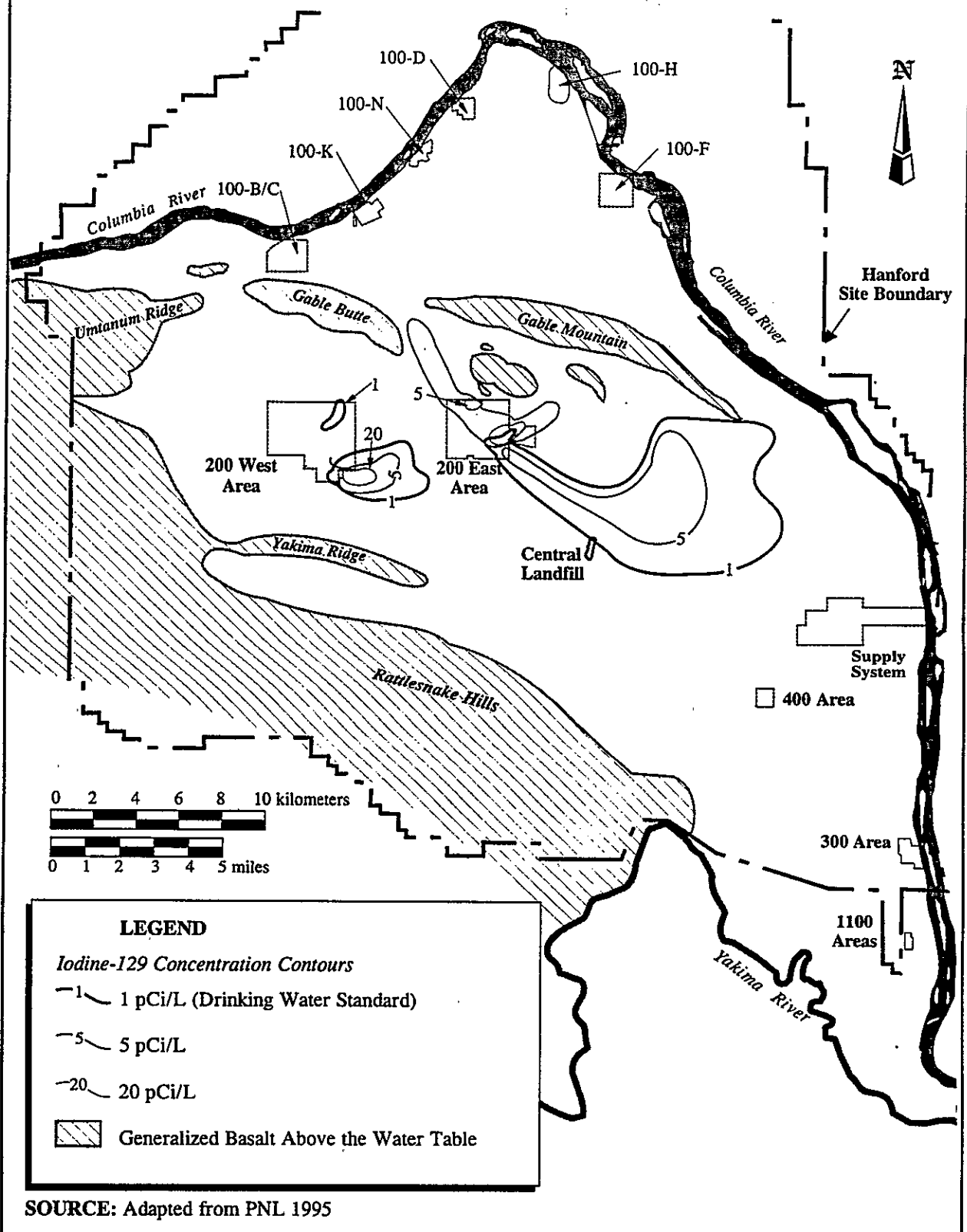


Figure I.2.2.5 Distribution of Nitrate in the Unconfined Aquifer, 1994



SOURCE: Adapted from PNL 1995

Figure I.2.2.6 Distribution of Iodine-129 in the Unconfined Aquifer, 1994



200 West Areas, downward hydraulic gradients have been observed (Trent 1992a and 1992b). In general, these downward hydraulic gradients are associated with the moundings that have been created from infiltration of water discharged to the U Pond and B Pond. Away from these mounds, the vertical gradients are smaller. For instance, near the Grout Treatment Facility in the 200 East Area, which is located along the central portion of the eastern part of 200 East, the vertical head differences between nearby well pairs are so slight that they are indistinguishable from measurement errors (Trent 1992b). For information on the impact of the mounds on future groundwater flow see Appendix F, Section F.2.4.1.2.

I.2.2.4.4 Aquifer Communication

Aquifer communication is a process in which groundwaters from distinct hydrogeological systems intermingle and mix. Of importance to the EIS is the degree of aquifer communication that exists between the unconfined aquifer and the underlying confined aquifer (Rattlesnake Ridge aquifer [Trent 1992b]). Several methods have been used to estimate the degree of aquifer communication at the Hanford Site including: analysis of joint and fracture systems in the basalt and presence of erosional windows, hydraulic head comparisons between aquifers, analysis and comparison of contaminant concentrations in adjacent aquifers, stable isotope analysis, and analysis of contaminant concentrations in adjacent aquifers. In summary, based on the above approaches, areas of aquifer communication currently appear to be limited to the vicinity of B Pond, where a substantial downward vertical gradient exists due to the mounding associated with infiltration from the pond (Trent 1992b).

I.2.3 WATER QUALITY AND SUPPLY

Water for the Hanford Site is supplied by the Columbia River via distribution systems located at the 100B, 100D, 200, and 300 Areas, and at the Washington Public Power Supply System reactor. Wells supply water to the 400 Area and facilities at several remote locations. The city of Richland supplies water to the 700, 1100, and 3000 Areas.

Richland, Pasco, and Kennewick draw water from the Columbia River and operate their own water supply and treatment systems. Richland derives approximately 67 percent of its water from the Columbia River, 15 to 20 percent from a well field in North Richland, and the remaining 13 to 18 percent from groundwater wells (Cushing 1995). Richland's total water use in 1994 was $2.6\text{E}+10$ L (6.9 billion gal).

The city of Pasco also obtains its water from the Columbia River and in 1994 consumed an estimated $8.6\text{E}+9$ L (2.3 billion gal) of that water (Cushing 1995). The city of Kennewick's water supply is derived from the Columbia River and two wells. The wells serve as the sole source of water between November and March. The total maximum water supply for Kennewick is approximately $2.8\text{E}+10$ L (7.3 billion gal). The wells can supply approximately 62 percent of that total. Kennewick's total water use in 1994 was $1.5\text{E}+10$ L (3.9 billion gal) (Cushing 1995).

I.2.3.1 Surface Water

Surface waters considered for this EIS are onsite ponds, riverbank springs and seeps at the Columbia River, and the waters of the Columbia River. Water quality in ephemeral creeks is not known to be impacted by Hanford Site activities.

I.2.3.1.1 Columbia River

River water samples are routinely collected at the sample locations shown on Figure I.2.3.1. Additionally, river water samples have been collected at cross sections established at the Vernita Bridge upstream of the Hanford Site, and at the Richland City Pumphouse, downstream of the Hanford Site.

Radionuclides consistently detected in river water at statistically substantial levels in 1994 were tritium, Sr-90, I-129, U-234, U-238, Pu-239, and Pu-240. I-129, Pu-239, and Pu-240 (PNL 1995). Strontium-90, and tritium may come from worldwide fallout, as well as from releases of Hanford Site effluent. Tritium and U also occur naturally in the environment. The levels of these radionuclides detected in the Columbia River in 1994 were well below established concentrations for drinking water. Radionuclide concentrations at Priest Rapids Dam (upstream of the Site) generally were lower than those at the Richland Pumphouse (downstream from the Site), and were similar to levels observed in recent years.

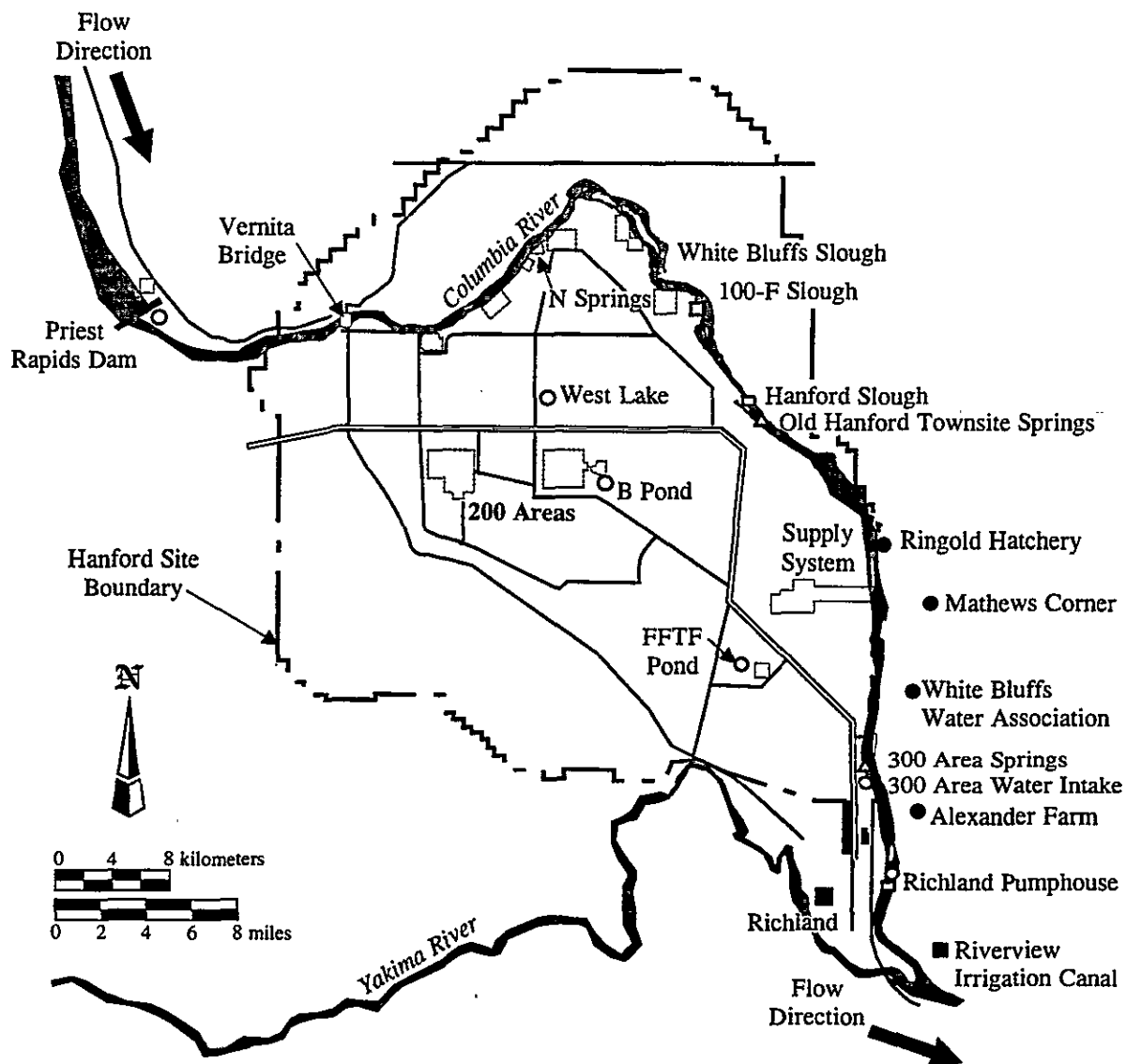
I.2.3.1.2 Ponds

Three ponds on the Hanford Site are routinely sampled: West Lake (located north of the 200 East Area), B Pond (located east of the 200 East Area), and the Fast Flux Test Facility Pond (located southeast of the 200 Areas) (PNL 1993a). Sampling data indicated that the ponds are impacted by Hanford Site activities, although the ponds are not used for human consumption. With the exception of U-234 and U-235 in the July 1994 sample of West Lake, all radionuclide concentrations were less than the DOE Derived Concentration Guides (DOE 1993k). The Federal and Washington State drinking water and surface water standards for total alpha were exceeded in all West Lake samples and in one B Pond sample. The U.S. Environmental Protection Agency's (EPA) proposed Hanford Site-specific drinking water standards for U also was exceeded in West Lake. All other radionuclide concentrations were within the range of results reported in recent years (PNL 1995). West Lake surface water quality reflects the quality of the groundwater that feeds the lake (PNL 1993a).

Riverbank Springs and Seeps

Riverbank spring discharges have been documented along the Hanford Reach of the Columbia River since before the startup of Hanford Site operations. They have been observed to be of relatively small volume and to occur intermittently (PNL 1993a). Several springs in the 100 Areas, as well as the Old Hanford Townsite Springs and the 300 Area Springs, are routinely sampled. Water flows from these springs are a mechanism by which groundwater contaminated by past Site activities enter the river. Various radiological contaminants and hazardous chemicals (e.g., chromium and trichlorethylene) were detected in 1994 (PNL 1995). All radiological contaminants were less than the applicable DOE Derived Concentration Guides. However, Sr-90 in the 100-D and 100-H Areas, tritium in the 100-N Area and along the Old Hanford Townsite, and total alpha in the 300 Area

Figure I.2.3.1 Water and Sediment Sampling Locations, 1992



SOURCE: Adapted from PNL 1993a

exceeded Federal and Washington State drinking water, surface, and groundwater standards. Total U exceeded the proposed EPA Hanford Site-specific drinking water standards (PNL 1995). All 1994 nonradiological contaminant concentrations were below Federal and Washington State primary drinking water, surface water, and groundwater standards with the exception of chromium and nitrates (NO_3).

I.2.3.2 Groundwater

I.2.3.2.1 Supply

Groundwater is not used in the 200 Areas except for emergency purposes. Three wells for emergency cooling water are located near B Plant in the 200 East Area. Water for drinking, most emergency uses, and facilities processes is obtained from the Columbia River. There are no water supply wells downgradient of the 200 Areas. Water supply wells on the Hanford Site are located at the Yakima Barricade, 6 km (4 mi) west of the 200 West Area; in the 400 Area, 16 km (10 mi) southeast of the 200 Areas; and at the Hanford Safety Patrol Training Academy, 25 km (16 mi) southeast of the 200 Areas.

I.2.3.2.2 Water Quality

Contamination by both radionuclide and nonradionuclide contaminants has been identified in the groundwater beneath the Hanford Site. Liquid effluents have been discharged to various ponds, cribs, and other Hanford Site waste management structures. Adsorption into soil particles, chemical precipitation, and ion exchange attenuate or delay the movement of some radionuclides and nonradionuclide contaminants in the effluent as they percolate downward through the vadose zone (PNL 1993a).

Constituents such as Sr-90, Cs-137, Pu-239, and Pu-240 are attenuated to varying degrees but eventually enter the groundwater. Compounds such as nitrate and radionuclides such as tritium, Tc-99, and I-129 are not readily attenuated in the soil and reach the groundwater sooner than those that are. These ions then travel downgradient at the same rate as the natural groundwater (PNL 1993a). Figure I.2.2.4 shows the distribution of tritium in the unconfined groundwater. Two other major contaminant plumes include nitrates (Figure I.2.2.5) and I-129 (Figure I.2.2.6).

Groundwater beneath the 200 Areas and in plumes leading from the 200 Areas toward the Columbia River is contaminated with hazardous chemicals and radionuclides at levels that exceed Federal drinking water standards and State groundwater criteria. Hazardous chemical contaminants present at levels exceeding drinking water standards and State groundwater criteria include nitrates, cyanide, fluoride, chromium, chloroform, carbon tetrachloride, trichloroethylene, and tetrachloroethylene. Radiological contaminants include I-129, tritium, Cs-137, Pu-239, Pu-240, and Sr-90. Generally, the groundwater contamination beneath the 200 Areas substantially exceeds drinking water standards and State groundwater criteria. For example, I-129 is present at levels that exceed standards by up to 20 times. While other groundwater plumes from the 200 Areas tend to have lower levels of contaminants than the I-129 levels, many contaminants still exceed drinking water standards and State

groundwater criteria. Groundwater use is controlled at the Hanford Site to prevent use of contaminated groundwater.

I.2.3.2.3 200 East Area

Unconfined groundwater beneath the 200 East Area contains 13 different contaminants that have been mapped as plumes: arsenic, chromium, cyanide, nitrate, gross alpha, gross beta, tritium, Co-60, Sr-90, Tc-99, I-129, Cs-137, Pu-239, and Pu-240 (DOE 1993a).

I.2.3.2.4 200 West Area

Beneath the 200 West Area, thirteen overlapping contaminant plumes are located within the unconfined gravels of Ringold Unit E: Tc-99, U, nitrate, carbon tetrachloride, chloroform, trichloroethylene, I-129, gross alpha, gross beta, tritium, arsenic, chromium, and fluoride (DOE 1993b). The tank farms are within the boundaries of most of these plumes. Plumes of Tc-99, U, I-129, gross alpha, and gross beta are associated with the U Plant area.

I.3.0 METEOROLOGY AND AIR QUALITY

The following subsections discuss Hanford Site climatology and air quality. The meteorological section summarizes measurements of wind, temperature and humidity, precipitation, fog and visibility, severe weather, and atmospheric dispersion. The air quality section includes information on standards, pollutant emissions, and air monitoring results.

I.3.1 METEOROLOGY

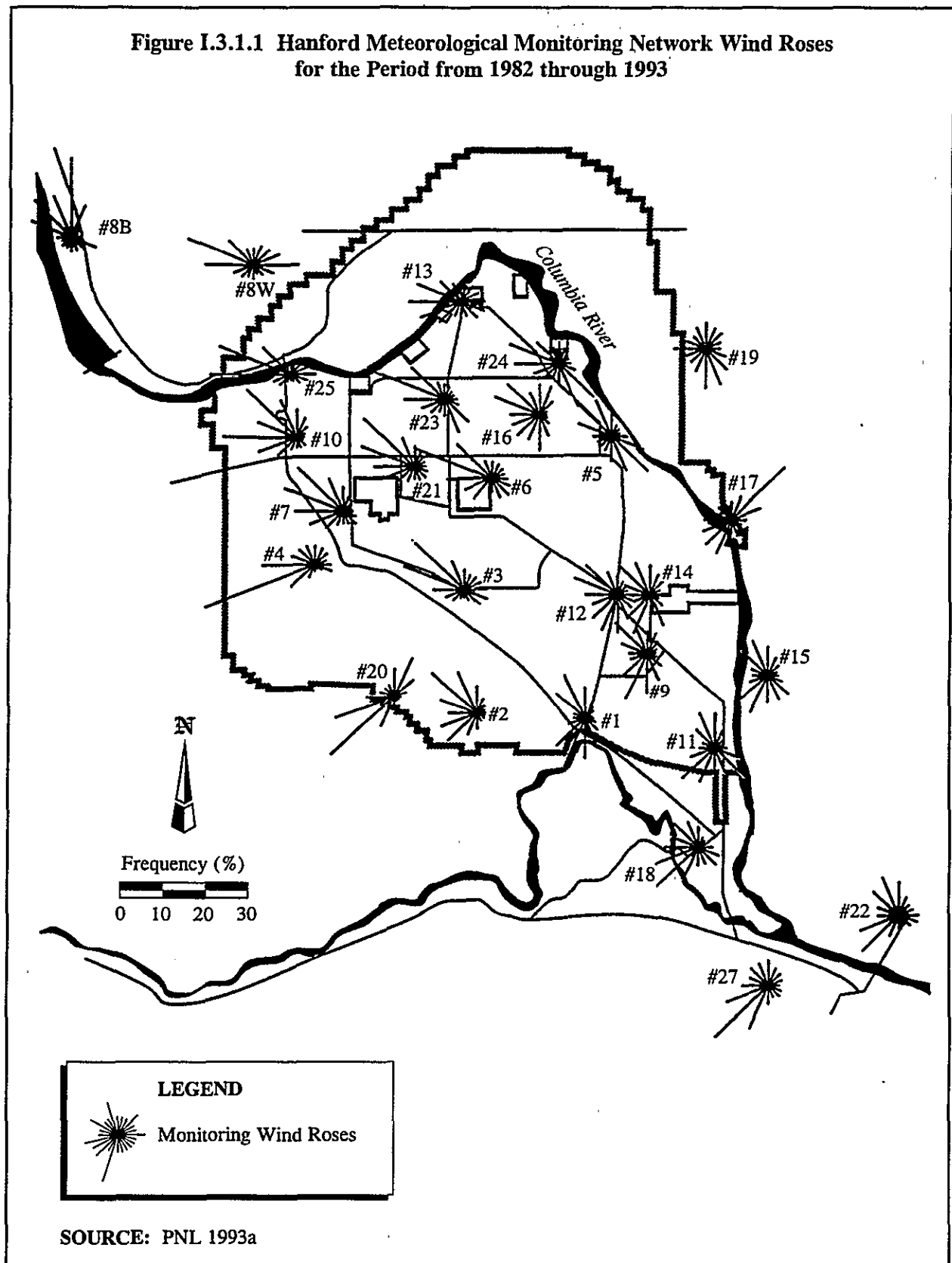
The Cascade Mountains greatly influence the climate of the Hanford Site by their rain shadow effect. This range also serves as a source of cold air drainage, which has a considerable effect on the wind regime over the Site.

Climatological data has been collected at Hanford Meteorological Monitoring Network sites. The Hanford Meteorological Station (HMS), located between the 200 East and 200 West Areas, is the most completely instrumented station. The data is considered representative for assessing proposed TWRS activities. The following meteorological discussion is largely based on the Hanford Climatological Summaries (Stone et al. 1972), as well as information compiled by Cushing (Cushing 1994).

I.3.1.1 Wind

Figure I.3.1.1 shows winds measured at the Meteorological Monitoring Network sites. Prevailing winds at the HMS are from the west-northwest and northwest in all months of the year. Monthly average wind speeds are lowest during December, averaging 10 km (6 mi) per hour, and highest during June, averaging approximately 15 km (9 mi) per hour. The most prevalent wind speed class, 6 km (4 mi) to 11 km (7 mi) per hour, occurs 36 percent of the time. Wind speeds are less than 21 km (13 mi) per hour 84 percent of the time, and greater than 29 km (18 mi) per hour less than 5 percent of the time. Peak gusts occur from the south-southwest, southwest, and west-southwest during all months.

Figure I.3.1.1 Hanford Meteorological Monitoring Network Wind Roses for the Period from 1982 through 1993



I.3.1.2 Temperature and Humidity

From 1961 through 1990, the average monthly temperatures varied from -1 °centigrade (C) (30.3 °Fahrenheit [F]) in January to 24.6 °C (76.2 °F) in July with a yearly average of 11.8 °C (53.2 °F). On the average, 51 days during the year (April through September) had maximum temperatures greater than or equal to 32 °C (90 °F), and 12 days (May through September) had a maximum temperature greater than or equal to 37.8 °C (100 °F). Also, an average of 25 days during the year (October through February) experienced maximum temperatures less than 0 °C (32 °F). An average of 106 days per year (October through April) experienced minimum temperatures less than 0 °C (32 °F). An average of 4 days per winter season (November through February) experienced daily minimum temperatures less than -18 °C (0 °F) but approximately half of all winters were free of such days. The record maximum and minimum temperatures recorded during the period 1945 to 1991 were 45 °C (113 °F) in 1961 and -45 °C (-23 °F) in 1950.

The annual average relative humidity, based on data from the years 1950 through 1993, was 54.5 percent. Relative humidity was highest during the winter months, averaging 80.2 percent in December, and lowest during the summer, averaging 33.3 percent in July.

I.3.1.3 Precipitation

The average annual precipitation measured at the HMS is 17 cm (6.6 in.). The bulk of the precipitation (54 percent) occurs during November through February. As the wettest month, December receives an average of 2.5 cm (1 in.) while July averages 0.5 cm (0.2 in.) and is the driest month. On the average, only 1 day per year experiences precipitation greater than 1.3 cm (0.5 in.), and 68 days per year have precipitation greater than 0.02 cm (0.01 in.) per year. An average of 125 days per year receive a trace amount or more of precipitation. The monthly total time during which precipitation occurs ranges from 12.4 percent in December to 1.5 percent in July. Winter monthly average snowfall ranges from 0.8 cm (0.3 in.) in March to 13.5 cm (5.3 in.) in January. Yearly snowfall has ranged from 0.8 cm (0.3 in.) to 140 cm (56 in.). Annual average snowfall is 38 cm (15 in.).

I.3.1.4 Fog and Visibility

Although fog (visibility less than or equal to 10 km [6 mi]), has been recorded during every month of the year at the HMS, nearly 90 percent of the occurrences are during the late fall and winter months. The months of April through September account for only about 1 percent of the occurrences. On average, 46 days per year experience fog and 24 days per year experience dense fog (visibility less than or equal to 0.4 km [0.25 mi]).

Other phenomena restricting visibility to 10 km (6 mi) or less include dust, blowing dust, and smoke (typically from wildfires, orchard smudging, and agricultural field burning). An average of 5 days per year have dust or blowing dust and only about 2 days per year have reduced visibility resulting from smoke. On an annual basis, 3.8 percent of the hourly observations recorded for the years 1960 through 1980 indicate restricted visibility because of all phenomena.

I.3.1.5 Severe Weather

Severe high winds are associated with thunderstorms. On average the Hanford Site may experience 10 thunderstorms per year, most frequently (80 percent) occurring May through August.

However, thunderstorms have been observed to occur in every month of the year. Estimates of the extreme wind velocities, based on peak gusts observed from 1945 through 1980, are shown in Table I.3.1.1 (Stone et al. 1983).

Tornadoes are smaller and less frequent in the northwest portion of the United States than elsewhere in the country. There were no reports of violent tornadoes for the region surrounding the Hanford Site. The HMS climatological summary (Stone et al. 1983) and the National Severe Storms Forecast Center database list 22 separate tornado occurrences within 160 km (100 mi) of the Hanford Site from 1916 through August 1982. Two additional tornadoes have been reported since August 1982.

Table I.3.1.1 Estimates of Extreme Winds at the Hanford Site

Return Period, year	Peak, Gusts, km/h (mi/h)	
	15 m (50 ft) Aboveground	60 m (200 ft) Aboveground
2	97 (61)	109 (68)
10	114 (71)	129 (81)
100	137 (86)	151 (94)
1000	159 (99)	175 (109)

Notes:

km/hr = kilometers per hour

mi/hr = miles per hour

The probability of a tornado striking at the Hanford Site has been estimated to be approximately one in 10,000 (NRC 1977).

I.3.1.6 Atmospheric Dispersion

Atmospheric dispersion is a function of wind speed, duration and direction of wind, atmospheric stability, and mixing depth. Dispersion conditions are generally good if winds are moderate to strong, the atmosphere is of neutral or unstable stratification, and there is a deep mixing layer. Good dispersion conditions associated with neutral and unstable stratification exist about 57 percent of the time during the summer at the Hanford Site. Less favorable dispersion conditions may occur when the wind speed is light and the mixing layer is shallow. These conditions are most common during the winter when moderately to extremely stable stratification exists about 66 percent of the time.

Less favorable conditions also occur periodically for surface and low-level releases in all seasons from sunset to 1 hour after sunrise as a result of ground-based temperature inversions and shallow mixing layers. Mixing layer thicknesses have been estimated at the HMS using remote sensors.

These variations in mixing layer are summarized in Table I.3.1.2.

Table I.3.1.2 Percent Frequency of Mixing-Layer Thickness by Season and Time of Day

Mixing Layer, m (ft)	Winter		Summer	
	Night	Day	Night	Day
Less than 250 m (830 ft)	65.7	35.0	48.5	1.2
250 to 500 m (830 to 1,700 ft)	24.7	39.8	37.1	9.0
Greater than 500 m (1,700 ft)	9.6	25.2	14.4	89.9

The Hanford Site may experience occasional extended periods of poor dispersion conditions associated with stagnant air in stationary high-pressure systems that occur primarily during the winter months. The probability of an inversion period (e.g., poor dispersion conditions) extending more than 12 hours varies from a low of about 10 percent in May and June to a high of about 64 percent in September and October (Stone et al. 1972).

I.3.2 AIR QUALITY

Federal and State ambient air quality standards have been set for a limited number of pollutants. Monitoring is conducted to measure levels of selected pollutants that can then be compared to the standards.

I.3.2.1 Air Quality Standards

National Ambient Air Quality Standards (NAAQS) have been established by EPA, as mandated in the 1970 Clean Air Act. Ambient air is the portion of the atmosphere, external to buildings, that is accessible to the general public. The NAAQS define levels of air quality that, with an adequate margin of safety, are protective of public health (primary standards) and welfare (secondary standards). NAAQS exist for the following six criteria pollutants; sulfur oxides (measured as sulfur dioxide), nitrogen dioxide, carbon monoxide, particulate matter (PM-10, measured as particles less than 10 micrometers aerodynamic diameter), lead, and ozone. The standards specify the maximum pollutant concentrations and frequencies of occurrence that are allowed for various averaging periods ranging from 1 hour to 1 year depending on the pollutant.

Washington State has largely adopted the current NAAQS. However, Washington State has established more stringent standards for sulfur dioxide and ozone and maintains an air quality standard for total suspended particulates and gaseous fluorides. Table I.3.2.1 summarizes the NAAQS and supplemental Washington State standards.

The Hanford Site also evaluates concentrations of selected pollutants for which national and State ambient air quality standards do not exist. For toxic organic compounds (e.g., toluene, benzene), comparisons are made to the Occupational Safety and Health Administration's maximum allowable concentrations (29 Code of Federal Regulations [CFR] 1910). Concentrations of polychlorinated biphenyls (PCBs) are compared against the National Institute of Occupational Safety and Health limit of 1,000 nanograms per m³ as a 10-hour time-weighted average.

Table I.3.2.1 Federal and Washington State Ambient Air Quality Standards

Pollutant	Federal		Washington State
	Primary	Secondary	
Total suspended particulates			
Annual (geometric mean)	NS	NS	60 µg/m³
24-hr	NS	NS	150 µg/m³
PM-10			
Annual (arithmetic mean)	50 µg/m³	50 µg/m³	50 µg/m³
24-hr	150 µg/m³	150 µg/m³	150 µg/m³
Sulfur Dioxide			
Annual	0.03 ppm	NS	0.02 ppm
24-hr	0.14 ppm	NS	0.1 ppm
3-hr	NS	0.50 ppm	NS
1-hr	NS	NS	0.4 ppm ¹
Carbon Monoxide			
8-hr	9 ppm	9 ppm	9 ppm
1-hr ¹	35 ppm	35 ppm	35 ppm
Ozone			
1-hr ²	0.12 ppm	0.12 ppm	0.12 ppm
Nitrogen Dioxide			
Annual	0.05 ppm	0.05 ppm	0.05 ppm
Lead			
Quarterly average	1.5 µg/m³	1.5 µg/m³	1.5 µg/m³
Gaseous Fluorides ³			
12-hr ⁴	-	-	3.7 µg/m³
24-hr ⁵	-	-	2.9 µg/m³
7-day ⁶	-	-	1.7 µg/m³
30-day ⁷	-	-	0.84 µg/m³
March 1 through October 31	-	-	0.5 µg/m³

Notes:

¹ 0.25 ppm not to be exceeded more than two times in any 7 consecutive days.² Not to be exceeded more than 1 day per calendar year.³ Measured as hydrogen fluoride.⁴ Average over any 12 consecutive hours.⁵ Average over any 24 consecutive hours.⁶ Average over any 7 consecutive days.⁷ Average over any 30 consecutive days. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

NS = no standard

ppm = parts per million

I.3.2.2 Emission Sources

Sources of airborne emissions at the Hanford Site include combustion equipment (e.g., steam boilers, electric generation plants), coal handling operations, chemical separation processes, storage tanks, waste handling, and waste disposal. These activities result in routine emissions of air pollutants, including radionuclides.

The Clean Air Act amendments of 1990 established a new national permitting system for major sources of air pollution, and other categories of sources, such as facilities with equipment subject to a National Emission Standard for Hazardous Air Pollutants (NESHAP). The Hanford Site is classified as a major source for one or more criteria pollutants, as well as for hazardous air pollutants. The Hanford Site is currently subject to the radionuclide NESHAP of 10 millirems (10 mrem) per year. DOE has applied for a Sitewide Air Operating Permit for the Hanford Site, which will cover all substantial emission sources for which the Site is considered a major source.

For areas in attainment of the NAAQS, the EPA has established the Prevention of Significant Deterioration (PSD) program to protect existing ambient air quality while at the same time allowing a margin for future growth. Under the PSD program, new stationary sources of air pollution may only impact air quality by set increments and they must install best available control technology emission controls. The Hanford Site obtained a PSD permit in 1980 requiring specific limits for oxides of nitrogen emitted from the PUREX Plant.

I.3.2.3 Air Quality Monitoring

Air quality data have been collected at onsite and offsite locations. The following discussion concentrates on recent monitoring activities conducted largely for the purpose of assessing air quality impacts from the Hanford Site. The information was taken from the Hanford Site Environmental Report (PNL 1995) and from the Site NEPA Characterization Report (Cushing 1995).

I.3.2.3.1 Onsite Monitoring

Onsite air quality monitoring was conducted during 1990 for nitrogen oxides (NO₂) at three locations. The monitoring was discontinued after 1990 because the primary source ceased operation. The highest annual average concentration was less than 0.006 parts per million (ppm), well below the applicable Federal and Washington State annual ambient standard of 0.05 ppm.

Nine of a total 17 PCB samples collected during 1993 were below the detection limit of 29 nanograms per m³ (μg/m³). Eight PCB samples were above the detection limit, with values ranging from 0.25 to 3.9 μg/m³, all well below the National Institute of Occupational Safety and Health occupational limit of 1,000 μg/m³. Fourteen volatile organic compound samples were obtained in 1993. All samples analyzed for benzene, alkylbenzenes, halogenated alkanes, and alkenes were within allowable limits. Volatile organic compound data from 1994 were within a similar range of values and also were within allowable limits.

I.3.2.3.2 Offsite Monitoring

The only offsite monitoring in the vicinity of the Site in 1993 was conducted by Washington State Department of Ecology. PM-10 was monitored at Columbia Center in Kennewick. The State's 24-hour PM-10 standard was exceeded twice in 1993. The maximum reading was $1,166 \mu\text{m}^3$, with the suspected cause being windblown dust. There was no exceedance of the annual primary standard of $50 \mu\text{g}/\text{m}^3$ (Cushing 1995).

Particulate concentrations can reach relatively high-levels in eastern Washington State because of exceptional natural events (i.e., dust storms, volcanic eruptions, and large brushfires) that occur in the region. State ambient air quality standards have not distinguished rural fugitive dust from exceptional natural events when estimating the maximum background concentrations of particulates in the area east of the Cascade Mountain crest. No decision has been made to designate Benton County a nonattainment area pending studies to determine the source of high local PM-10 concentrations. It is suspected that the high readings are due to natural conditions (e.g., dust storms, brush fires) rather than man-made pollution.

I.3.2.3.3 Radiological Monitoring

Data were collected in 1994 through a system of 39 radiological monitoring stations located onsite, at the Site perimeter, in nearby communities (e.g., Richland, Kennewick, and Pasco), and in distant communities (Sunnyside and Yakima). Cesium-137, Pu-239, Pu-240, Sr-90, and U were consistently detected in air samples collected in the 200 Areas. Concentrations of these radionuclides were higher than concentrations measured offsite. The levels measured at both onsite and offsite locations were within allowable limits. Levels in the 200 Areas are generally on a downward trend because of facility shutdowns and improved environmental management. No clear trends were observed with respect to offsite levels (PNL 1995).

I.4.0 BIOLOGICAL AND ECOLOGICAL RESOURCES

This section describes the ecological resources potentially impacted by the proposed action and alternatives. A brief description of the regional environment is followed by a discussion of the ecological resources of the Central Plateau and nearby areas, which are the location of all facilities under all alternatives addressed in this EIS. The material presented is based largely on reports by Cushing (Cushing 1994 and 1995), which summarize many other site studies, on the 1994 biological survey of the TWRS site in the 200 East Area (PNL 1994e), and on the Site Evaluation Report for Candidate Basalt Quarry Sites (Duranceau 1995).

The Hanford Site and adjacent region have been characterized as shrub-steppe (Daubenmire 1970). Shrub-steppe vegetation zones are dominated by a shrub overstory with an understory of grasses. The Hanford Site has not been farmed or grazed by livestock for more than 50 years, allowing it to serve as a refuge for a variety of plant and animal species (Gray-Rickard 1989). Approximately 665 km^2 (257 mi^2) of undeveloped land within the Hanford Site have been designated as ecological study areas or refuges. Washington State considers shrub-steppe a priority habitat because of its importance to wildlife species of concern.

I.4.1 BIODIVERSITY

Biodiversity has been defined as the diversity of ecosystems, species, and genes, and the variety and variability of life (CEQ 1993). Major components of biodiversity are plant and animal species, microorganisms, ecosystems, and ecological processes, and the interrelationships between and among these components. Biodiversity also is a qualitative measure of the richness and abundance of ecosystems and species in a given area (NPS 1994).

Two major factors that contribute to biodiversity on the Hanford Site are 1) the Site is one of the largest relatively undisturbed tracts of native shrub-steppe left in Washington State; and 2) the Hanford Reach, which is the last free-flowing nontidal stretch of the Columbia River in the United States (Sackschewsky et al. 1992 and Cushing 1994). Other factors include topographic features such as Rattlesnake Mountain, Gable Butte, and Gable Mountain, a variety of soil textures ranging from sand to silty and sandy loam, and the lack of human use and development over much of the Hanford Site. Specialized terrestrial habitats contributing to the biodiversity of the Hanford Site include areas of shrub-steppe, basalt outcrops, scarps (cliffs), scree slopes (accumulations of material at the base of a hole or cliff), and sand dunes. Aquatic components of biodiversity are mainly associated with the Columbia River and include aquatic habitat, wetland and riparian areas, and riverain habitat along the Hanford Reach shoreline and islands in the Columbia River.

The biological diversity of the Hanford Site has been emphasized by the recent discovery of nine species (two plant and seven insects) in a study by the Nature Conservancy of Washington (Stang 1995). These species may be dependent on the shrub-steppe environment and destruction, fragmentation, or other disturbance of this habitat could lead to the loss of these and other as yet unidentified species.

Ecologically important plant and animal species on the Hanford Site include species of concern (Section I.4.6); commercial and recreational wildlife species such as salmon and steelhead, mule deer, and upland game birds; and plant species used as a source of food, medicine, fiber, and dye in the traditional lifestyles of Native People of the Columbia Basin (Section I.4.7) (Sackschewsky et al. 1992).

As stated previously, the Hanford Site has not been farmed or grazed for over 50 years and thus has served as a refuge for various plant and animal species. However, the invasion and spread of nonnative plant species into previously disturbed areas, such as abandoned farmland, represent a potential threat to biodiversity by displacing native species, simplifying plant communities, and fragmenting habitat. Introduced plant species account for approximately 21 percent of the vascular plants found on the Hanford Site and include species such as cheatgrass, Russian-thistle, and most of the tree species found onsite (Sackschewsky et al. 1992). Most of the Site's disturbed areas include abandoned farmland and areas burned by wildfire. These areas are dominated by pure stands of cheatgrass where the native shrub component has been modified severely or replaced altogether (Cushing 1994).

I.4.2 VEGETATION

The Hanford Site is a relatively undisturbed area of shrub-steppe; which is considered priority habitat by Washington State (WSDW 1993). Historically, the predominant plant in the area was big sagebrush (*Artemisia tridentata*) with an understory of perennial bunch grasses such as Sandbergs bluegrass (*Poa sandbergii*) and bluebunch wheatgrass (*Agropyron spicatum*). Following human settlement in the early 1800's, grazing and agriculture disrupted the native vegetation and opened the way for invader species such as tumbleweed or Russian-thistle (*Salosa kali*) and cheatgrass (*Bromus tectorum*). Establishing the Hanford Site as a nuclear facility in 1943 created a protected area of mostly undeveloped land with scattered, small industrial complexes. Consequently, the Hanford Site is one of a small number of remaining shrub-steppe tracts in Washington State that is relatively undisturbed.

The Central Plateau and the nearby areas of the potential McGee Ranch and Vernita Quarry borrow sites have been identified as predominantly shrub-steppe (Cushing 1994 and Duranceau 1995). This designation includes communities dominated by big sagebrush and bitterbrush (*Purshia tridentata*) with an understory of cheatgrass or Sandbergs bluegrass (Figure I.4.2.1). Over 100 plant species occur on the Central Plateau and vicinity. Common plant species include big sagebrush, rabbitbrush (*Chrysothamnus nauseous*), cheatgrass, and Sandbergs bluegrass, with cheatgrass providing over half of the vegetative cover (Table I.4.2.1). Much of the 200 Areas (e.g., the tank farms, the sites of several large processing facilities), have been disturbed by human activities. In these disturbed areas, introduced species, such as Russian-thistle and cheatgrass are common (Cushing 1994).

The TWRS sites in the 200 East Area and the immediate surrounding area are approximately 40 percent big sagebrush and rabbitbrush. Another 20 percent is dominated by Russian-thistle, with the remainder disturbed vegetation or bare gravel (PNL 1994e). The proposed Phased Implementation alternative site in the easternmost portion of the 200 East Area is comprised of approximately 65 percent shrub-steppe, with the remaining area disturbed by the construction in the 1980's of the unused Grout Treatment Facility (ASI 1995).

Other vegetation in the 200 Areas includes wetland species associated with man-made ditches and ponds and introduced perennial grass planted to revegetate disturbed areas. Wetland species such as cattail, reeds, and various trees, such as willow, cottonwood, and Russian-olive, are established around some of these ponds (Cushing 1992). However, several of the ponds have been decommissioned, which eliminated the supply of industrial water feeding the ponds. Without the water supply, the artificial wetland habitat was eliminated. None of the wetlands or ponds are near the TWRS sites.

Introduced perennial grass, such as Siberian-wheatgrass (*Agropyron sibericum*), has been used extensively in the 200 Areas to revegetate and stabilize waste burial grounds against wind and water erosion. Siberian-wheatgrass has proven to be drought tolerant and better adapted to sandy soil than other species used in the 200 Area's revegetation (Stegen 1993).

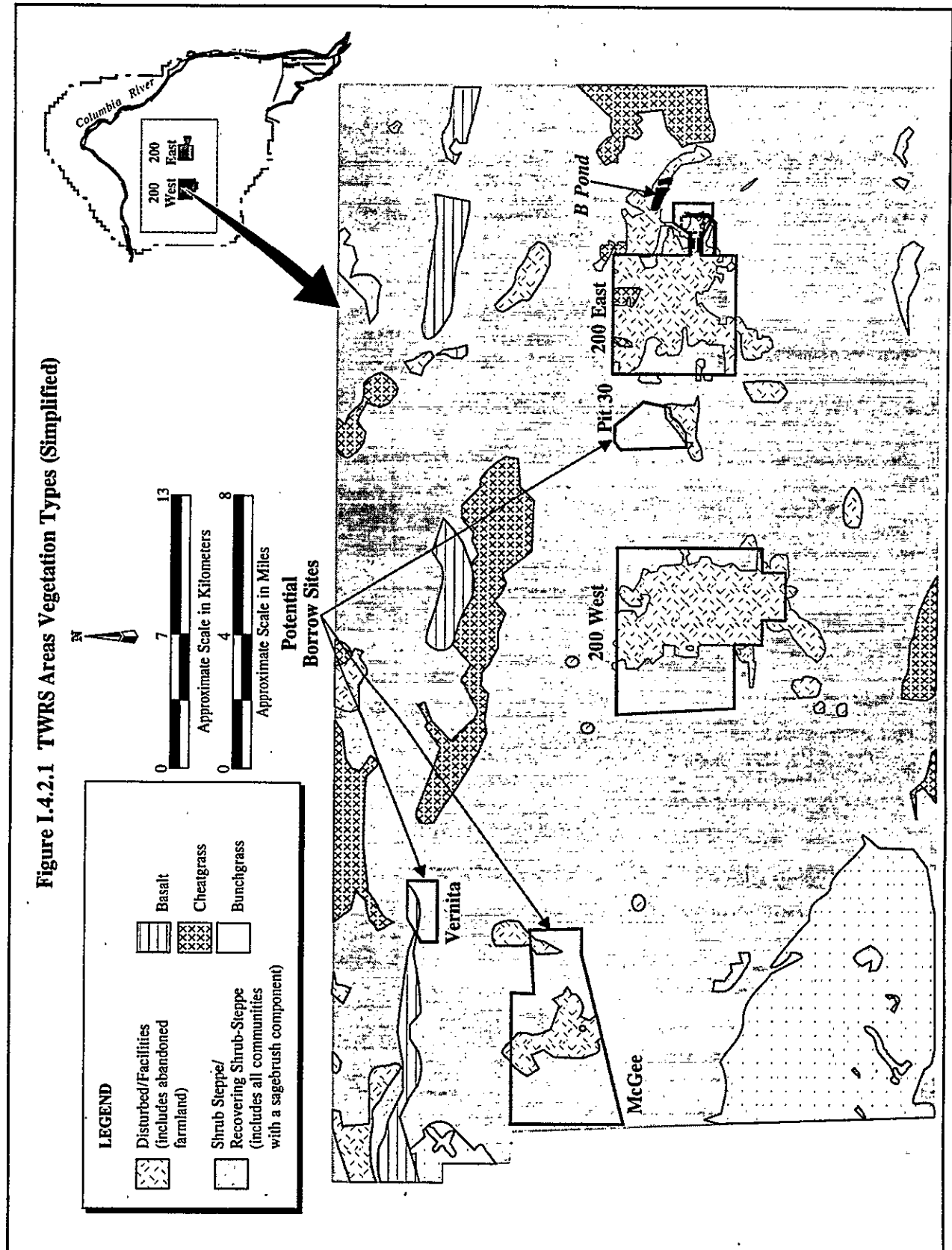


Table I.4.2.1 Common Vascular Plants Found on the Hanford Site

Scientific Name	Common Name
Shrub-Steppe Species	
Shrubs	
<i>Artemisia tridentata</i>	big sagebrush
<i>Chrysothamnus nauseosus</i>	grey rabbitbrush
<i>Chrysothamnus viscidiflorus</i>	green rabbitbrush
<i>Eriogonum niveum</i>	snowy buckwheat
<i>Grayia (Atriplex) spinosa</i>	spiny hopsage
<i>Purshia tridentata</i>	bitterbrush
Perennial Grasses	
<i>Agropyron dasystachyum</i>	thick-spike wheatgrass
<i>Agropyron desertorum (cristatum)</i>	crested wheatgrass
<i>Agropyron sibericum</i>	Siberian-wheatgrass
<i>Agropyron spicatum</i>	bluebunch wheatgrass
<i>Oryzopsis hymenoides</i>	Indian-ricegrass
<i>Poa sandbergii (secunda)</i>	Sandbergs bluegrass
<i>Sitanion hystrix</i>	bottlebrush squirreltail
<i>Sporobolus cryptandrus</i>	sand dropseed
<i>Stipa comata</i>	needle-and-thread grass
Perennial Forbs	
<i>Achillea millefolium</i>	yarrow
<i>Arenaria franklinii</i>	sandwort
<i>Astragalus caricinus</i>	buckwheat milkvetch
<i>Astragalus sclerocarpus</i>	stalked-pod milkvetch
<i>Balsamorhiza careyana</i>	balsamroot
<i>Brodiaea douglasii</i>	cluster lily
<i>Comandra umbellata</i>	comandra
<i>Cymopterus terebinthinus</i>	turpentine cymopterus
<i>Erigeron filifolius</i>	threadleaf milkbane
<i>Fritillaria pudica</i>	yellow bell
<i>Helianthus cusickii</i>	Cusick sandflower
<i>Lomatium grayi</i>	Gray desert-parsley
<i>Machaeranthera canescens</i>	hoary aster
<i>Oenothera pallida</i>	pale evening primrose
<i>Penstemon acuminatus</i>	Beard tongue
<i>Phlox longifolia</i>	long-leaved phlox
<i>Psoralea lanceolata</i>	scurf pea
<i>Rumex venosus</i>	sand dock
<i>Sphaeralcea munroana</i>	desert mallow
<i>Thelypodium lanciniatum</i>	thelypody
Shrub-Steppe Species	
Shrubs	
<i>Artemisia tridentata</i>	big sagebrush
<i>Chrysothamnus nauseosus</i>	grey rabbitbrush
<i>Chrysothamnus viscidiflorus</i>	green rabbitbrush
<i>Eriogonum niveum</i>	snowy buckwheat
<i>Grayia (Atriplex) spinosa</i>	spiny hopsage
<i>Purshia tridentata</i>	bitterbrush

Table I.4.2.1 Common Vascular Plants Found on the Hanford Site (cont'd)

Scientific Name	Common Name
Annual Forbs <i>Ambrosia acanthicarpa</i> <i>Amsinckia lycopsoides</i> <i>Chaenactis douglasii</i> <i>Chorispora tenella</i> <i>Crepis atrabarba</i> <i>Cryptantha circumscissa</i> <i>Cryptantha pterocarya</i> <i>Descurainia pinnata</i> <i>Draba verna</i> <i>Epilobium paniculatum</i> <i>Erodium cicutarium</i> <i>Erysimum asperum</i> <i>Holosteum umbellatum</i> <i>Lastuca serriola</i> <i>Lepidium perfoliatum</i>	ragweed fiddleneck tarweed false yarrow purple mustard hawk beard matted cryptantha cryptantha tansy mustard spring draba willow-herb filaree (cranes bill) western wall flower jagged chickweed prickly lettuce pepperweed
Annual Grasses <i>Bromus tectorum</i> <i>Festuca microstachys</i> <i>Festuca octoflora</i>	cheatgrass small fescue six-weeks fescue
Riparian Plants Trees and Shrubs <i>Apocynum cannabinum</i> <i>Morus alba</i> <i>Populus trichocarpa</i> <i>Prunus</i> spp. <i>Robinia pseudo-acacia</i> <i>Salix amygdaloides</i> <i>Salix exigua</i> <i>Salix</i> spp.	dogbane white mulberry black cottonwood peach, apricot, cherry black locust peachleaf willow sand bar willow willow
Shrub-Steppe Species Shrubs <i>Artemisia tridentata</i> <i>Chrysothamnus nauseosus</i> <i>Chrysothamnus viscidiflorus</i> <i>Eriogonum niveum</i> <i>Grayia (Atriplex) spinosa</i> <i>Purshia tridentata</i>	big sagebrush grey rabbitbrush green rabbitbrush snowy buckwheat spiny hopsage bitterbrush

Table I.4.2.1 Common Vascular Plants Found on the Hanford Site (cont'd)

Scientific Name	Common Name
Perennial Grasses and Forbs	
<i>Allium</i> spp.	wild onion
<i>Artemisia campestris</i>	pacific sage
<i>Artemisia ludoviciana</i>	prairie sage
<i>Carex</i> spp.	sedge
<i>Centurea repens</i>	Russian-knapweed
<i>Coreopsis atkinsonia</i>	tickseed
<i>Eleocharis</i> spp.	wiregrass
<i>Equisetum</i> spp.	horsetail
<i>Gaillardia aristata</i>	gaillardia
<i>Grindelia columbiana</i>	gumweed
<i>Heterotheca villosa</i>	golden aster
<i>Juncus</i> spp.	rushes
<i>Lupinus</i> spp.	lupine
<i>Phalaris arundinacea</i>	reed canary grass
<i>Polygonum persicaria</i>	smartweed
<i>Scirpus</i> spp.	bulrushes
<i>Solidago occidentalis</i>	goldenrod
<i>Typha latifolia</i>	cattail
<i>Veronica anagallis-aquatica</i>	speedwell
Aquatic Vascular	
<i>Elodea canadensis</i>	waterweed
<i>Lemna minor</i>	duckweed
<i>Myriophyllum spicatum</i>	water milfoil
<i>Potamogeton</i> spp.	pondweed
<i>Rorippa nasturtium-aquaticum</i>	watercress
<i>Rorippa columbiae</i>	Columbia yellow cress

Source: Cushing 1992

At the potential Vernita Quarry borrow site, the areas at the top of the basalt cliffs have very low shrub densities, primarily big sagebrush and rigid sagebrush. Grasses such as bluebunch wheatgrass and Sandbergs bluegrass are common. Areas between and below the basalt cliffs have shrub coverage of 30 to 40 percent, primarily big sagebrush with some spiny hopsage and prickly phlox (Duranceau 1995).

The potential McGee Ranch borrow site contains a wide variety of shrubs and flowering plants. Large portions of the site are covered with a dense stand of big sagebrush and spiny hopsage. This area has a Sandbergs bluegrass understory with very little cheatgrass or other alien weed species (Duranceau 1995). Approximately 25 percent of the site is abandoned farmland and is dominated by cheatgrass and Russian-thistle. The McGee Ranch area also is an important vegetation and wildlife corridor linking the Hanford Site and the Yakima Training Center, which are two largest shrub-steppe areas remaining in Washington State (Fitzner 1992).

The Nature Conservancy of Washington recently discovered a new species of buckwheat in the Umtanum Ridge area, which is in the same general area of the Hanford Site as McGee Ranch and Vernita Quarry (Stang 1995).

I.4.3 WILDLIFE

Approximately 290 species of terrestrial vertebrates have been observed at the Hanford Site, including 41 species of mammals, 238 species of birds, three species of amphibians, and nine species of reptiles (Weiss-Mitchell 1992). Major terrestrial habitat types occurring on the Site include basalt outcrops, scarps and scree, riparian and riverain areas, shrub-steppe, sand dunes and blowouts, and abandoned fields (Downs et al. 1993).

I.4.3.1 Mammals

Common large mammal species include the mule deer and Rocky Mountain elk; predators such as coyotes, bobcats, and badger; and a variety of small mammals (Table I.4.3.1). Elk were not present when the Hanford Site was established in 1943 and did not appear onsite until 1972. The elk occur primarily on the Fitzner Eberhardt Arid Land Ecology (FEALE) Reserve (PNL 1993a). Mule deer may occur almost anywhere on the Hanford Site, although concentrations are highest along the Columbia River between the Hanford townsite and the B Reactor area (Rickard et al. 1989).

White-tailed deer are occasionally sighted along the Columbia River and at the Yakima River Delta near Richland (Fitzner-Gray 1991). Six species of bats also occur on the Hanford Site, primarily as fall or winter migrants, with some using abandoned buildings as roosting sites (Cushing 1992).

I.4.3.2 Birds

Bird species on the Site include a variety of raptors, songbirds, and species associated with riparian, riverain, and upland habitats. Approximately 240 species of birds, including migrants and accidental species, have been observed at the Hanford Site (Landeem et al. 1992). Of these, 36 are common species (Table I.4.3.2) and 40 occur as accidental species (Cushing 1994).

Common raptors that may occur onsite year-round are the northern harrier, red-tailed hawk, golden eagle (*Aquila chrysaetos*), prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius*), barn owl (*Tyto alba*), great horned owl (*Bubo virginianus*), and long-eared owl (*Anotis olus*) (Fitzner-Gray 1991). Raptors use a variety of habitats for nesting and foraging at the Hanford Site. Nest habitat include outcrops and cliffs, trees, marsh lands and fields, and utility towers. Depending on raptor size and species, prey may include small mammals, birds, reptiles such as snakes, and insects.

A variety of passerine (songbird) species is known to occur in the shrub-steppe vegetation type on the Hanford Site. These include the western meadowlark (*Sturnella neglecta*), grasshopper sparrow (*Ammodramus savannarum*), horned lark (*Eremophila alpestris*), and sage thrasher (*Oreoscoptes montanus*) (Downs et al. 1993). The western meadowlark and horned lark are the most abundant shrub-steppe passerine bird species that breed on the Hanford Site (Rickard-Poole 1989). The western meadowlark and horned lark nest on the ground in the open, while shrub-steppe species like the sage sparrow, sage thrasher, and loggerhead shrike require sagebrush or bitterbrush for nesting habitat.

Table I.4.3.1 List of Mammals Occurring on the Hanford Site

Scientific Name	Common Name
<i>Antrozous pallidus</i>	pallid bat
<i>Brachylagus idahoensis</i>	pygmy rabbit
<i>Canis latrans</i>	coyote
<i>Castor canadensis</i>	beaver
<i>Cervus elaphus</i>	elk
<i>Erethizon dorsatum</i>	porcupine
<i>Eutamias minimus</i>	least chipmunk
<i>Lagurus curtatus</i>	sagebrush vole
<i>Lasionycteris noctivagans</i>	silver-haired bat
<i>Lasiurus cinereus</i>	hoary bat
<i>Lepus californicus</i>	black-tailed jackrabbit
<i>Lepus townsendi</i>	white-tailed jackrabbit
<i>Lutra canadensis</i>	river otter
<i>Lynx rufus</i>	bobcat
<i>Marmota flaviventris</i>	yellow-bellied marmot
<i>Mephitis mephitis</i>	striped skunk
<i>Microtus montanus</i>	montane meadow mouse
<i>Mus musculus</i>	house mouse
<i>Mustela erminea</i>	short-tailed weasel
<i>Mustela frenata</i>	long-tailed weasel
<i>Mustela vison</i>	mink
<i>Myotis californicus</i>	California brown bat
<i>Myotis lucifugus</i>	little brown bat
<i>Myotis yumanensis</i>	Yuma brown bat
<i>Neotoma cinerea</i>	bushy-tailed woodrat
<i>Odocoileus hemionus</i>	mule deer
<i>Odocoileus virginianus</i>	white-tailed deer
<i>Ondatra zibethicus</i>	muskrat
<i>Onychomys leucogaster</i>	northern grasshopper mouse
<i>Perognathus parvus</i>	Great Basin pocket mouse
<i>Peromyscus maniculatus</i>	deer mouse
<i>Plecotus townsendii townsendii</i>	Pacific western big-eared bat
<i>Procyon lotor</i>	raccoon
<i>Rattus norvegicus</i>	Norway rat
<i>Reithrodontomys megalotis</i>	western harvest mouse
<i>Sorex merriami</i>	Merriam shrew
<i>Sorex vagrans</i>	vagrant shrew
<i>Spermophilus townsendii</i>	Townsend ground squirrel
<i>Sylvilagus nuttallii</i>	Nuttall cottontail rabbit
<i>Taxidea taxus</i>	badger
<i>Thomomys talpoides</i>	northern pocket gopher

Source: Cushing 1992

Table I.4.3.2 Common Birds Occuring on the Hanford Site

Scientific Name	Common Name
<i>Agelaius phoeniceus</i>	red-winged blackbird
<i>Anas acuta</i>	northern pintail
<i>Anas americana</i>	American wigeon
<i>Anas clypeata</i>	northern shoveler
<i>Anas platyrhynchos</i>	mallard
<i>Ardea herodias</i>	great blue heron
<i>Aythya americana</i>	redhead
<i>Branta canadensis</i>	Canada goose
<i>Bucephala albeola</i>	bufflehead
<i>Calidris mauri</i>	western sandpiper
<i>Calidris minutilla</i>	least sandpiper
<i>Carpodacus mexicanus</i>	house finch
<i>Charadrius vociferus</i>	killdeer
<i>Chordeiles minor</i>	common nighthawk
<i>Columba livia</i>	rock dove
<i>Corvus corax</i>	common raven
<i>Dendroica coronata</i>	yellow-rumped warbler
<i>Eremophila alpestris</i>	horned lark
<i>Fulica americana</i>	American coot
<i>Hirundo pyrrhonota</i>	cliff swallow
<i>Hirundo rustica</i>	barn swallow
<i>Junco hyemalis</i>	dark-eyed junco
<i>Larus californicus</i>	California gull
<i>Larus delawarensis</i>	ring-billed gull
<i>Limnodromus scolopaceus</i>	long-billed dowitcher
<i>Mergus merganser</i>	common merganser
<i>Numenius americanus</i>	long-billed curlew
<i>Passer domesticus</i>	house sparrow
<i>Pica pica</i>	black-billed magpie
<i>Podilymbus podiceps</i>	pied-billed grebe
<i>Sturnella neglecta</i>	western meadowlark
<i>Sturnus vulgaris</i>	european starling
<i>Turdus migratorius</i>	American robin
<i>Tyrannus verticalis</i>	western kingbird
<i>Zenaidura macroura</i>	mourning dove
<i>Zonotrichia leucophrys</i>	white-crowned sparrow

Source: Cushing 1992

Common upland game bird species include the chukar partridge (*Alectoris chukar*), california quail (*Callipepla californica*), and chinese ring-necked pheasant (*Phasianus colchicus*). Sage grouse (*Centrocercus urophasianus*) and gray partridge (*Perdix perdix*) are less common and rarely seen. Sage grouse, although once more common, are now essentially absent is placed from the Hanford Site since a major wildfire in 1984 (Brandt 1995). None of the upland birds are native to the area except the sage grouse.

I.4.3.3 Reptiles and Amphibians

Nine species of reptiles and three species of amphibians occur on the Hanford Site (Table I.4.3.3) (Fitzner-Gray 1991). The most abundant reptile is the side-blotched lizard (*Uta stansburiana*) (Cushing 1992). The short-horned lizard (*Phrynosoma douglassii*) and northern sagebrush lizard (*Sceloporus graciosus*) are also common in mature sagebrush habitats with sandy soil. Common snakes include the gopher snake (*Pituophis melanoleucus*), yellow-bellied racer (*Coluber constrictor*),

and pacific rattlesnake (*Crotalus viridis*). Less common are striped whipsnakes (*Masticophis taeniatus*) and desert night snakes (*Hypsiglena torquata*). Amphibians on the Hanford Site are associated with riparian habitats located along permanent water bodies or the Columbia River (Fitzner-Gray 1991). Included are the Great Basin spadefoot (*Spea intermontana*), Woodhouses toad (*Bufo woodhouseii*), and the Pacific tree frog (*Hyla regilla*).

Table I.4.3.3 Amphibians and Reptiles Occurring on the Hanford Site

Scientific Name	Common Name
Amphibians	
<i>Bufo woodhouseii</i>	Woodhouse toad
<i>Hyla regilla</i>	Pacific treefrog
<i>Spea intermontana</i>	Great Basin spadefoot
Reptiles	
<i>Chrysemys picta</i>	painted turtle
<i>Coluber constrictor</i>	western yellow-bellied racer
<i>Crotalus viridis</i>	western rattlesnake
<i>Hypsiglena torquata</i>	desert night snake
<i>Masticophis taeniatus</i>	striped whipsnake
<i>Phrynosoma douglassii</i>	short-horned lizard
<i>Pituophis melanoleucus</i>	gopher snake
<i>Sceloporus graciosus</i>	sagebrush lizard
<i>Uta stansburiana</i>	side-blotched lizard

Source: Cushing 1992

I.4.3.4 Insects

The Nature Conservancy of Washington, in an ongoing multi-year inventory project, has identified approximately 600 species or genres of insects on the Hanford Site, with specimens of 300 to 400 additional species awaiting identification. This includes the discovery of three new species of bees and four new species of leafhopper insects (Stang 1995).

Table I.4.3.4 lists the relative abundance (percentage) of insect taxa collected from three shrub species on the Site. Grasshoppers and darkling beetles represent some of the more conspicuous insect groups. The populations of both of these species of insects are subject to seasonal changes and weather variations (Rogers-Rickard 1977). Fifty percent of the known insect species are of the order Coleoptera (beetles) (ERDA 1975). Many of the insect species are important in the food web of birds and mammals found onsite. Species like the darkling beetle play an important role in the decomposition process by feeding on decaying plant material, animal excrement, fungi, and live plant tissue (Weiss-Mitchell 1992).

Table I.4.3.4 Relative Abundance of Insect Taxa Collected from Sagebrush, Rabbitbrush, and Hopsage

Taxa	Sagebrush (%)	Rabbitbrush (%)	Hopsage (%)
Araneida	6.5	20.7	21.3
Coleoptera	1.7	1.9	27.4
Diptera	1.1	1.2	5.3
Hemiptera	44.6	11.7	6.4
Homoptera	33.0	31.2	6.1
Hymenoptera	4.2	2.9	5.8
Lepidoptera	1.2	6.1	5.3
Neuroptera	0.3	0.3	0.3
Orthoptera	7.3	24.0	21.8
Other	0.1	0.1	0.3

Source: Cushing 1992

I.4.4 AQUATIC ECOLOGY

Aquatic habitats on the Hanford Site are primarily associated with the Columbia River, two small spring-fed streams on the FEALE Reserve, and artificial ponds and ditches occurring in or near the 200 Areas. Past studies (Cushing-Watson 1974, Emery-McShane 1978, and Cushing 1994) describe the ecology of some of these ponds. The Columbia River supports a large and diverse community of plankton, benthic invertebrates, fish, and other communities. The springs are also diverse and productive (e.g., dense watercress blooms and fairly high aquatic insect populations). The artificial ponds and ditches, many of which are now abandoned and dried out, often provide lush riparian habitat and support populations of migratory and breeding birds, particularly waterfowl. No extensive discussions are provided of Site aquatic habitats because none of them are in close proximity to any TWRS sites.

I.4.5 SENSITIVE HABITATS

Sensitive habitats on the Hanford Site include wetlands and riparian habitats. Wetlands include those transitional lands occurring between terrestrial and aquatic ecosystems where the water table is usually close to the surface or where shallow water covers the surface (Cowardin et al. 1979). The primary wetlands found on the Site occur along the Hanford Reach of the Columbia River and include the riparian habitats located along the river shoreline. Other wetland habitats found on the Hanford Site are associated with man-made ponds and ditches. These include B Pond and its associated ditches located near the 200 East Area. The B Pond Complex was constructed in 1945 to receive cooling water from facilities in that area. Wetland plants occurring along the shoreline of B Pond include herbaceous and woody species such as showy milkweed (*Asclepias speciosa*), western goldenrod (*Solidago occidentalis*), three square bulrush (*Scirpus americanus*), horsetail (*Equisetum* sp.), rush (*Juncus* sp.), common cattail (*Typha latifolia*), mulberry (*Morus alba*), silver poplar (*Populus alba*), black cottonwood (*Populus trichocarpa*), and willow (*Salix* sp.) (Sackschewsky et al. 1992). Wildlife species observed at B Pond include a variety of mammals and waterfowl species (Meinhardt-Frostenson 1979).

I.4.6 SPECIES OF CONCERN

Species of concern on the Hanford Site include Federally-listed threatened and endangered species, Federal candidate species, Washington State threatened or endangered species, State candidate species, State monitor species, State sensitive plant species, and species of ethnobiological concern to Native Americans.

Species of concern occurring on the Hanford Site are listed in Tables I.4.6.1 and I.4.6.2, along with definitions of each category. No Federally-listed threatened or endangered plant or animal species occur in the 200 Areas, at the potential Pit 30 borrow site located between the 200 East and 200 West Areas, or at the potential Vernita Quarry and McGee Ranch borrow sites. (Sackschewsky et al. 1992). Pipers daisy (*Erigeron piperianus*), a State sensitive species, has been found at B Pond near the 200 East Area and at Pit 30. The crouching milkvetch, stalked-pool milkvetch, and scilla onion, all State Class 3 monitor species, are also found in the 200 East Area.

Wildlife species of concern observed or considered likely to be found on or near the Central Plateau include the sage sparrow (*Amphispiza belli*), loggerhead shrike (*Lanius Ludovicianus*), and Swainsons hawk (*Buteo swainsoni*). The loggerhead shrike and sage sparrow commonly nest in undisturbed shrub-steppe habitat. The sage sparrow is one of the most common nesting birds on the Hanford Site (Downs et al. 1993). Other bird species of concern that may be found include the burrowing owl, ferruginous hawk, Swainsons hawk, golden eagle, sage thrasher, and prairie falcon (Cushing 1994).

Nonavian wildlife species of concern using the Central Plateau and vicinity include the striped whipsnake (*Mastocophis taeniatus*), which is a State candidate species; the desert night snake (*Hypsiglena torquata*), which is a State monitor species; the northern sagebrush lizard, a Federal Category 2 candidate species, and the pygmy rabbit, a Federal Category 2 candidate and State threatened species (Rogers-Rickard 1977).

To understand the role of the Central Plateau in terms of ethnobiology, the role of the natural environment in a culture, it is necessary to briefly describe the subsistence life-style of the Native Americans that have long resided in the general area (Hunn 1990). The Native American people that resided along the reach of the Columbia River flowing through what is now the Hanford Site followed a seasonal, migratory life-style, as did the majority of Native American people along the Columbia River. They concentrated on salmon fishing at Priest Rapids in the summer and early fall (June through October) when weather and water conditions combined with salmon migration provided a productive fishery. In the spring, they moved towards the areas now known as Moses Lake and Ephrata to gather roots, at one time a substantial component of their diet. In the late fall, the Native Americans moved to the surrounding mountains to gather berries and hunt. In the winter they returned to lower, warmer, elevations along the river where they over-wintered in semi-permanent long-houses. Although Native Americans followed a well-defined pattern of movement throughout the year, they fished for other species when salmon were not present, hunted whenever the opportunity was available, and gathered available, edible food plants.

Table I.4.6.1 Plant Species of Concern on the Hanford Site

Scientific Name	Common Name	Status*
<i>Allium robinsonii</i>	Robinsons onion	M3
<i>Allium scilloides</i>	squill onion	M3
<i>Arenaria franklinii</i> v. <i>thompsonii</i>	Tompsons sandwort	FC3b, M2
<i>Artemisia campestris</i> var. <i>wormskioldii</i>	northern wormwood	FC1, SE
<i>Artemisia lindleyana</i>	Columbia River mugwort	M3
<i>Astragalus columbianus</i>	Columbia milkvetch	FC2, ST
<i>Astragalus sclerocarpus</i>	stalked-pod milkvetch	M3
<i>Astragalus speirocarpus</i>	medick milkvetch	M3
<i>Astragalus succumbens</i>	crouching milkvetch	M3
<i>Balsamorhiza rosea</i>	rosy balsamroot	M3
<i>Carex densa</i>	dense sedge	S
<i>Cirsium brevifolium</i>	palouse thistle	M3
<i>Cryptantha interrupta</i>	bristly cyptantha	S
<i>Cryptantha leucophaea</i>	gray cryptantha	S
<i>Cuscuta denticulata</i>	desert dodder	M1
<i>Cyperus rivularis</i>	shining flatsedge	S
<i>Erigeron piperianus</i>	Pipers daisy	S
<i>Limosella acaulis</i>	southern mudwort	S
<i>Lindernia anagallidea</i>	false-pimpernel	S
<i>Lomatium tuberosum</i>	Hoovers desert-parsley	FC2, ST
<i>Oenothera pygmaea</i>	dwarf evening-primrose	S
<i>Pellaea glabella</i>	smooth cliffbrake	M3
<i>Penstemon eriantherus</i>	fuzzy beardtongue	M3
<i>Rorippa columbiae</i>	Columbia yellowcress	FC2, SE
<p>* Plant species of concern status definitions:</p> <p><u>State Definitions</u> (WSDNR 1990)</p> <p>SE - State endangered: Plant taxa that are in danger of becoming extinct or extirpated within the near future if factors contributing to their decline continue.</p> <p>ST - State threatened: Plant taxa that are likely to become endangered within the near future if factors contributing to their population decline or habitat degradation continue.</p> <p>S - Sensitive: Plant taxa that are vulnerable or declining, and that could become endangered or threatened without active management or removal of threats.</p> <p>M1 - Monitor group 1: Plant taxa in need of further field work before a status can be assigned.</p> <p>M2 - Monitor group 2: Plant taxa with unresolved taxonomic questions.</p> <p>M3 - Monitor group 3: Plant taxa that are more abundant and less threatened than previously assumed.</p> <p><u>Federal Definitions</u> (50 CFR 17)</p> <p>FC1 - Candidate plant taxa for which enough substantial information on biological vulnerability and threat is available to support listing as threatened or endangered by the federal government.</p> <p>FC2 - Candidate plant taxa for which there is some evidence of vulnerability, but not enough data to support listing proposals at this time.</p> <p>FC3 - Candidate plant taxa that were once considered for listing as threatened or endangered but are no longer candidates for listing. Subcategory (FC3b) includes names that, on the basis of current taxonomic understanding, do not represent distinct taxa meeting the Endangered Species Act of 1973 definition of species.</p>		

Source: Sackschewsky et al. 1992

Table I.4.6.2 Wildlife Species of Concern on the Hanford Site

Scientific Name	Common Name	Status*
Mammals		
<i>Antrozous pallidus</i>	pallid bat	SM
<i>Brachylagus idahoensis</i>	pygmy rabbit	FC2, ST
<i>Lagurus curtatus</i>	sagebrush vole	SM
<i>Onychomys leucogaster</i>	northern grasshopper mouse	SM
<i>Plecotus townsendii</i>	pacific western big-eared bat	FC2, SC
<i>Sorex merriami</i>	merriams shrew	SC
Birds		
<i>Accipter gentilis</i>	northern goshawk	FC2, SC
<i>Aechmophorus clarkii</i>	clarks grebe	SM
<i>Aechmophorus occidentalis</i>	western grebe	SM
<i>Ammodramus savannarum</i>	grasshopper sparrow	SM
<i>Amphispiza belli</i>	sage sparrow	SC
<i>Aquila chrysaetos</i>	golden eagle	SC
<i>Ardea herodias</i>	great blue heron	SM
<i>Athene cunicularia</i>	burrowing owl	SC
<i>Branta canadensis leucopareia**</i>	aleutian canadian goose	FE, SE
<i>Buteo regalis</i>	ferruginous hawk	FC2, ST
<i>Buteo swainsoni</i>	swainsons hawk	SC
<i>Casero dius albus</i>	great egret	SM
<i>Cathartes aura</i>	turkey vulture	SM
<i>Centrocercus urophasianus</i>	western sage grouse	FC2, SC
<i>Chlidonias niger</i>	black tern	FC2, SM
<i>Falco columbarius</i>	merlin	SM
<i>Falco mexicanus</i>	prairie falcon	SM
<i>Falco peregrinus</i>	peregrine falcon	FE, SE
<i>Falco rusticolus</i>	gyrfalcon	SM
<i>Gavia immer</i>	common loon	SC
<i>Grus canadensis</i>	sandhill crane	SE
<i>Haliaeetus leucocephalus</i>	bald eagle	FT, ST
<i>Himantopus mexicanus</i>	black-necked stilt	SM
<i>Lanius ludovicianus</i>	loggerhead shrike	FC2, SC
<i>Melanerpes lewis</i>	lewis woodpecker	SC
<i>Myiarchus cinerascens</i>	ash-throated flycatcher	SM
<i>Numenius americanus</i>	long-billed curlew	SM
<i>Nyctea scandiaca</i>	snowy owl	SM
<i>Nycticorax nycticorax</i>	black-crowned night heron	SM
<i>Oreoscoptes montanus</i>	sage thrasher	SC
<i>Otus flammeolus</i>	flamulated owl	SC
<i>Pandion haliaetus</i>	osprey	SM
<i>Pelecanus erythrorhychos</i>	white pelican	SE
<i>Podiceps grisegena</i>	horned grebe	SM
<i>Podiceps grisegena</i>	red-necked grebe	SM
<i>Sialia mexicana</i>	western bluebird	SC
<i>Sterna caspia</i>	caspian tern	SM
<i>Sterna forsteri</i>	forsters tern	SM
<i>Sterna paradisaea</i>	arctic tern	SM
<i>Strix varia</i>	barred owl	SM
Reptiles		
<i>Hypsiglena torquata</i>	desert night snake	SM
<i>Masticophis taeniatus</i>	striped whipsnake	SC

Source: Downs et al. 1993, Stengen 1993, Landeen et al. 1992

Table I.4.6.2 Wildlife Species of Concern on the Hanford Site (cont'd)

Scientific Name	Common Name	Status*
Amphibians <i>Bufo woodhousei</i>	Woodhouses toad	SM
Fish <i>Catostomus platyrhynchus</i> <i>Cottus beldingi</i> <i>Cottus perplexus</i> <i>Percopsis transmontana</i>	mountain sucker Piute sculpin reticulate sculpin sand roller	SM SM SM SM
Mollusks <i>Fisherola nutalli</i> <i>Fluminicola columbiana</i>	short-faced lanx Columbia pebble snail	FC2, SC FC2, SC
Insects <i>Cicindela columbica</i>	Columbia River tiger beetle	SC
<p>* Species of concern status definitions: <u>Federal Definitions</u> (from Endangered Species Act, as amended by PL 100-707, November 23, 1988; Federal Register, Vol. 54, No. 4, January 6, 1989, Notice of Review-Animals, U.S. Fish and Wildlife Service) FE - Federal endangered A species in danger of extinction or extirpation throughout all or a substantial portion of its range. FT - Federal threatened A species that is likely to become endangered within the near future because of threats to its population. FC2 - Federal candidate for listing, Category 2 A species for which there is some evidence of vulnerability, but for which there are not enough data to support listing proposals at this time.</p> <p><u>State Definitions</u> (WSDW 1991) SE - State endangered A species native to Washington State that is seriously threatened with extinction throughout all or a substantial portion of its range within the state. Endangered species are designated in WAC 232-12-014. ST - State threatened A species native to Washington State likely to become endangered within the foreseeable future throughout substantial portions of its range within the state without cooperative management or the removal of threats. Threatened species are designated in WAC 232-12-011. SC - State candidate A wildlife species native to Washington State that the Department of Wildlife will review for possible listing as endangered, threatened, or sensitive. SM - State monitor A wildlife species native to Washington State of special interest because at one time it was classified as endangered, threatened, or sensitive; it requires habitat that has limited availability during some portion of its life cycle; it is an indicator of environmental quality; further field investigations are required to determine its population status; there are unresolved taxonomic problems that may bear upon its status classification; it may be competing with and impacting other species of concern; and it has substantial popular appeal.</p> <p>** Rare migrant or accidental occurrence on the Hanford Site (Downs et al. 1993).</p>		

Source: Downs et al. 1993, Stegen 1993, Landeen et al. 1992

The shrub-steppe associated with the Columbia Plateau has not historically supported large populations of big game (DeVoto 1953 and Irving 1976). Hunting, therefore, provided a small portion of the annual food supply, probably less than 30 percent (Hunn 1990). Mule deer were present, as were some antelope. Elk and bison may have wandered into the area occasionally. It is more likely that big

game hunting was associated with fall berry-gathering expeditions to areas where larger animals were more abundant. Because of the scarcity of big game, smaller mammals such as the yellow-bellied marmot, Beldings ground squirrel, Townsends ground squirrel, jackrabbits, and cottontails probably made up a large portion of the diet of Columbia Basin Native Americans. This has been substantiated by archeological finds along the Columbia River (Aikens 1993).

While abundant, birds did not make up a large part of the diet of the Native People along the Hanford Reach. Historically, the Hanford Reach of the Columbia River has been an important waterfowl wintering and breeding area. Waterfowl were netted or shot. Egg collecting probably contributed to the Native Americans diet. Birds and bird parts were used for medicinal purposes or as a part of religious practices. Bird parts were also used as decorations and to fletch arrows. Waterfowl and sage grouse probably made up the bulk of birds used for food (Hunn 1990).

Fish have been and remain an important part of the diet of the Native Americans residing along the Columbia River. Salmon played an important role in their diet, but suckers and other bottom fish are thought to have contributed as much to the diet as did salmon (Hunn 1990 and Aikens 1993).

For the Native Americans that live along the Columbia River, salmon and other fish continue to be an important part of their diet. The Columbia River Intertribal Fish Commission has determined that adult Native Americans consume an average of 59 grams of fish per day, which is nine times the average consumption rate for non-Native Americans (CRITFC 1994).

Plants have been and remain important to Native Americans along the Hanford Reach. Plants or plant parts provide food, medicine, cordage, building materials, and materials of religious significance. Several dozen plant species at the Hanford Site are considered to have uses in traditional Native American cultures and lifestyles. A number of these plants species were identified in 1994 biological surveys of the TWRS sites in the 200 East Area (Fortner 1994).

1.5.0 CULTURAL RESOURCES

The Hanford Site is abundant in cultural sites, including such items as archaeological sites, districts, and objects; standing historical structures, locations of important historic events; and places, objects, and living or nonliving sites that are important to the practice and continuity of traditional cultures. In most cases, cultural sites are finite, unique, fragile, and nonrenewable (PNL 1989).

Archaeological sites are considered to be substantial if they are eligible for inclusion in the National Register of Historic Places (NRHP). Properties are deemed to be eligible for the NRHP if they are important in American history, architecture, archaeology, engineering, or culture.

Three categories of cultural sites are commonly delineated: prehistoric resources, historic era sites, and ethnographic or traditional cultural sites. Prehistoric sites date from before the time of written records. In the interior Pacific Northwest, prehistory refers to the period of time predating Euro-American contact with the Native American cultures and societies of the region. Historic

resources are defined as those sites or properties that were occupied or used after written records became available. Structures must usually be at least 50 years old to be deemed historic. However, those items and structures that were built in support of the Manhattan Project during World War II, as well as those that are representations of the Hanford Site's defense mission during the Cold War must also be considered for historic significance (Harvey 1994). Ethnographic sites (traditional cultural sites with historic or socio-religious affiliations) are locations that are important to the heritage of contemporary communities.

The Hanford Site contains a rich diversity of known cultural sites in all three categories. The Site contains seven NRHP Districts as well as 645 sites and isolated finds representative of prehistoric, historic, and modern eras (Cushing 1995). The overall condition (i.e., integrity) and thus potential significance of Hanford Site cultural sites is high because the area has had limited public access for over 50 years. This restricted access has saved most archaeological sites from looting and other adverse impacts. Another contributing factor to the importance of the Site's cultural sites is that similar areas along the Columbia River have been inundated by hydroelectric development. The Hanford Site has not experienced this type of development nor the resultant depletion of cultural sites, because the reach of the Columbia River adjacent to the Hanford Site has not been dammed.

The Hanford Site is of particular importance to Native Americans, although no specific religious sites have been identified at the TWRS sites. The Hanford Site is considered to be a traditional homeland by many Native Americans.

Archaeological sites or artifacts in the 200 Areas are scarce. A review of existing data for the TWRS sites in the 200 East Area indicates that 28 cultural resource surveys have been previously conducted (ASI 1994). These surveys included 18 block-tract surveys, 7 linear surveys, and 3 historic well surveys. In all, these surveys covered approximately 1,350 ha (3,400 ac). The number of archaeological sites or artifacts recorded as the result of these surveys is limited. Findings recorded in the areas surrounding and including the TWRS sites in the 200 East Area consist of individual isolated artifacts and four archaeological sites. Cultural resource surveys of the TWRS sites and vicinity conducted in 1994 confirmed the overall scarcity of archeological sites and artifacts in the 200 East Area. These surveys indicate no archeological resources in the 200 East Area that are likely to meet the eligibility criteria for inclusion in the NRHP (PNL 1994a, b, c).

The portion of the 200 East Area where TWRS facilities are proposed includes potentially historic buildings and structures associated with the Hanford Site's defense mission. Some of these may meet NRHP eligibility criteria although they have not yet been evaluated for their historical significance. Evaluations of the buildings and structures in the 200 Areas are expected to be completed by 1996 (Cushing 1995). TWRS implementation is not expected to impact these structures.

The 200 West Area has not been as completely surveyed as the 200 East Area. However, a 1988 project by the Hanford Cultural Resources Laboratory surveyed 50 percent of the undisturbed, previously unsurveyed land in the 200 West Area. This survey recorded a small number of isolated

historical and prehistoric artifacts, and one extensive cultural feature that has historical significance, the White Bluffs Road (Chatters-Cadoret 1990). None of these sites or artifacts are near TWRS sites, except the White Bluffs Road.

I.5.1 PREHISTORIC RESOURCES

Current cultural resources survey data for the potential TWRS sites in the 200 East Area indicates an overall low probability for prehistoric materials in these locations. Much of the land surface in the 200 East Area has been extensively disturbed by construction and other development activity.

A previous archaeological survey of all the undeveloped portions of the 200 East Area had indicated no findings of archaeological sites or known areas of Native American interest (Chatters-Cadoret 1990). The 1994 cultural resources surveys of the TWRS site and surrounding areas found only individual isolated artifacts and sites (lithics and historic trashcan scatters) (PNL 1994a, b, c). Surveys of the proposed Phased Implementation alternative site in the easternmost portion of the 200 East Area have identified no archaeological sites or artifacts (Cadoret 1995).

As stated previously, a 50 percent survey of all undeveloped and unsurveyed portions of the 200 West Area recorded no prehistoric sites and one prehistoric artifact (Chatters-Cadoret 1990).

Cultural resources surveys of the potential Vernita Quarry borrow site recorded several prehistoric isolates and prehistoric sites. A number of prehistoric isolates and prehistoric sites were also recorded at the potential McGee Ranch borrow site. No prehistoric materials have been recorded at the potential Pit 30 borrow site. The Vernita Quarry and McGee Ranch sites are considered likely to contain more prehistoric materials (Duranceau 1995). Based on the scarcity of prehistoric resources in and around the 200 Areas, there is little likelihood of finding prehistoric resources at Pit 30.

I.5.2 HISTORICAL RESOURCES

The first Euro-Americans to enter this region were Lewis and Clark, who traveled along the Columbia and Snake rivers during their exploration of the Louisiana Territory from 1803 to 1806. Lewis and Clark were followed by fur trappers who also traversed the area on their way to more productive lands up and down the river and across the Columbia Basin. It was not until the 1860's that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach. Chinese miners began to work the gravel bars for gold. Cattle ranches opened in the 1880's and farmers soon followed. Several small, thriving towns including Hanford, White Bluffs, and Ringold, grew up along the riverbanks in the early 20th century. Other ferries were established at Wahluke and Richmond. The towns, settlements, and nearly all other structures were razed after the U.S. Government acquired the land for the Hanford Site in the early 1940's (PNL 1989 and Cushing 1994).

The historic White Bluffs Road extends northeast-southwest across the northwest corner of the 200 West Area. It was an important transportation route during the mining, cattle ranching, and settlement eras of the 19th century, before Washington became a state. In the early 20th century, the road apparently was the primary northeast-southwest route across what is now the Hanford Site.

The route was also used in prehistoric and historic times by Native Americans as a trail that connected Rattlesnake Springs with a Columbia River crossing at White Bluffs (Chatters-Cadoret 1990).

The White Bluffs Road has been nominated for the NRHP, although the segment in the 200 West Area is not considered to be a critical element in its historic value (Cushing 1994). The nomination to the NRHP is still pending. A 100 m (330 ft) easement has been created on either side of the road to protect it from uncontrolled disturbance (Cushing 1994).

Historic materials from Euro-American settlement activities of the 19th and early 20th centuries have been found at both the potential Vernita Quarry and McGee Ranch borrow sites (Duranceau 1995). The McGee Ranch area has been deemed eligible for nomination to the NRHP as the McGee Ranch and Cold Creek District, in large part because of its historic sites (Cadoret 1995). No historic materials have been recorded at the potential Pit 30 borrow site.

Additional historic materials are likely to exist at both McGee Ranch and Vernita Quarry (Duranceau 1995). There is a low likelihood of important historic sites at Pit 30, although one homestead era structure is located in the area (Cadoret 1995).

Of a more recent historical nature (World War II and the Cold War period) are the nuclear reactors and associated materials processing facilities that now dominate the Hanford Site. The construction of three reactor facilities (100-B, 100-D, and 100-F) began in March 1943 as part of the Manhattan Project. In late 1944, the first reactor (100-B) became operational. Plutonium production began in early 1945 and continued into the post-war period. Plutonium for the world's first nuclear explosion test at the Trinity Site in New Mexico and for the bomb that destroyed Nagasaki was produced at the 100-B Reactor (PNL 1989 and Cushing 1994).

Additional reactors and processing facilities were constructed after World War II during the Cold War. All the reactor buildings constructed during these periods still stand, although many of the ancillary support structures have been removed. Because of its significance in contributing to international and national historical events, the 100-B Reactor has been listed individually on the NRHP and is a National Mechanical Engineering Monument. Other Manhattan Project facilities have yet to be evaluated. Until a full evaluation addressing each individual structure is conducted, no statement can be made about NRHP eligibility status. As mentioned in Section I.5.0, evaluation of the historic value of structure and buildings in the 200 Areas is scheduled for completion in 1996 (Cushing 1995). The waste storage tanks in the 200 Areas may be considered historically substantial, and documentation of the history and use of examples of the various kinds of tanks (e.g., single-shell, double-shell) will be required (Griffith 1995).

The Advisory Council on Historic Preservation recognizes the need to balance the historic preservation of facilities with operational or health and safety issues. The DOE Richland Operations Office and the Washington State Historic Preservation Officer are formulating a Programmatic Memorandum of

Agreement that addresses cultural resources management of the built environment at the Hanford Site (Harvey 1995).

I.5.3 NATIVE AMERICAN RESOURCES

The Hanford Site is situated on lands ceded to the U.S. Government by the Confederated Tribes and Bands of the Yakama Indian Nation and the Confederated Tribes of the Umatilla Indian Reservation. The Yakama Indian Nation and the Confederated Tribes of the Umatilla Indian Reservation occupy reservations within 130 km (80 mi) of the Hanford Site. Until 1942, the Wanapum People resided on land that is now part of the Hanford Site. In 1942, the Wanapum People agreed to move from their residence near White Bluffs to the Priest Rapids Area. Treaties between the Tribal Nations and the U.S. Government reserved certain rights and privileges for Native Americans. These rights included the right to fish at all usual and accustomed places, the privilege of hunting and gathering traditional foods and medicines, and the privilege of pasturing livestock on open and unclaimed land. DOE has maintained the position that for security and safety reasons, Hanford Site land uses are not compatible with exercising the privileges of hunting and gathering and pasturing and thus these lands are not considered open and unclaimed.

The Hanford Site has been occupied by humans since the end of the last glacial period. Over 10,000 years of continuous prehistoric human activity in this largely desert environment is reflected by the extensive archaeological deposits along the river shores. Inland areas with water resources point to evidence of concentrated human activity. Recent surveys also indicate the extensive, although dispersed, use of arid lowlands for hunting. Graves are common in various settings and spirit quest monuments are still to be found on high, rocky summits of the mountains and buttes (Cushing 1994).

As mentioned previously, recent biological and cultural resource surveys of the TWRS sites and nearby areas in the 200 East Area found plant species that are of ethnobotanical significance to Native Americans (e.g., plants used for food or medicinal purposes).

Native Americans have retained traditional secular and religious ties to the Hanford Site. Certain landmarks such as Rattlesnake Mountain, Gable Mountain, Gable Butte, and various sites along the Columbia River are sacred to tribes. Native American people also consider numerous burial sites to be sacred (PNL 1989 and Cushing 1994). No specific sacred sites are known at any of the TWRS sites.

I.6.0 SOCIOECONOMICS

The socioeconomic analysis focuses on Benton and Franklin counties in Washington State. These counties make up the Richland-Kennewick-Pasco Metropolitan Statistical Area (MSA), also known as the Tri-Cities. This term is frequently used to designate the MSA. Other jurisdictions in Benton County include Benton City, Prosser, and West Richland. Connell is the largest city in Franklin County after Pasco. A number of neighboring counties: Yakima, Walla Walla, Adams, and Grant counties in Washington; and Umatilla and Morrow counties in Oregon are impacted by activities at the Hanford Site. In terms of socioeconomics, however, because about 93 percent of Hanford Site

employees live in Benton and Franklin counties, the Site's impacts on these other counties are very small (Serot 1995). Thus, no discussion of baseline conditions in the neighboring counties is provided.

In accordance with Federal environmental justice policy, a discussion is provided in Sections I.6.1.4 and I.6.1.5 concerning the distribution and size of minority and Native American and low-income populations within an 80 km (50 mi) radius of the Hanford Site (Executive Order [EO] 12898). This discussion provides the basis for the required identification of potential disproportionate and adverse environmental impacts of EIS alternatives on minority and Native American populations and low-income populations. The 80 km (50 mi) radius includes counties not otherwise covered in this socioeconomic section because overall Site socioeconomic impacts on these counties are very small. However, this section does identify the minority and Native American population and employment within the Hanford Site's primary zone of socioeconomic influence, the Tri-Cities MSA (Benton and Franklin counties).

Before World War II, the economy in the Tri-Cities MSA was based primarily on agriculture. Since World War II, the Hanford Site has been the largest factor in the local economy. Plutonium production and processing was the primary mission of the Site until 1988 when the Site's mission became waste management and environmental restoration. Basic and applied research became an important secondary mission continuing to present.

Changes in the Hanford Site's mission and the cancellation of a Washington Public Power Supply System project at Hanford in the early 1980's (after only one of three planned nuclear power plants was completed) have had a large impact on the economy of the Tri-Cities MSA, creating boom-bust cycles that have had ramifications for employment, population, housing, and infrastructure. Table I.6.0.1 details Hanford Site employment, Washington Public Power Supply System employment, and total nonfarm employment for the Tri-Cities MSA, together with population in the MSA for 1980 to 1994. The Tri-Cities is currently in the early stages of an economic transition as employment at the Hanford Site declines from its recent peak levels.

I.6.1 DEMOGRAPHICS

This section examines population characteristics in the Tri-Cities MSA and the effects of the Hanford Site on the demographics of the area.

I.6.1.1 Population Trends

Population tended to follow changes in nonfarm employment in the Tri-Cities area during the 1980's and early 1990's (Table I.6.0.1). Between 1981 and 1984, nonfarm employment fell by approximately 11,000 jobs, while population fell by about 6,000. Employment began to increase after 1984 but population continued to fall, hitting a low of 138,300 in 1989. Employment increased until 1987 and then fell in 1988 after the decision to close the last plutonium production reactor (N Reactor). Between 1988 and 1989, however, employment in the Tri-Cities jumped by almost 2,000 (despite a continued decline in Hanford Site employment). When employment began to increase again at the Hanford Site in 1990, population increased by almost 12,000, effectively returning to the 1981 level.

Table I.6.0.1 Population and Employment in the Richland-Kennewick-Pasco MSA, 1980 to 1994

Year	Hanford Site Employment	Washington Public Power Supply System Employment	Total Nonfarm Employment	Population
1980	12,100	7,935	58,710	144,469
1981	11,880	11,728	63,940	150,100
1982	11,357	8,841	58,860	147,900
1983	11,740	5,498	55,360	144,700
1984	12,891	2,015	52,870	144,000
1985	13,570	1,800	54,020	140,900
1986	14,015	1,745	55,230	139,300
1987	14,298	1,677	56,970	139,600
1988	13,433	1,633	55,400	139,600
1989	12,871	1,680	57,300	138,300
1990	14,152	1,762	62,200	150,030
1991	15,101	1,842	64,100	153,400
1992	16,209	1,904	66,400	157,700
1993	17,075	1,950	70,000	163,900
1994	18,388	1,750	72,300	169,900

Notes:

Data for 1990 through 1992 reflect revised estimates made in April 1994. Hanford Site employment includes DOE and major contractors. Washington Public Power Supply System employment includes contractors. 1993 and 1994 Washington Public Power Supply System employment levels are estimates.

MSA = Metropolitan Statistical Area

Source: WSDDES 1994, WSDFM 1987-95, Meeker 1994, Pitcher 1994, Cushing 1995

The population trends reflected actual employment in the MSA and expectations of employment. Once the economy began to grow in the late 1980's, people moved into the area, some because they had jobs but many others because they were searching for work. The population of the Tri-Cities area continued to grow as the Site and total nonfarm employment increased through 1994. No data is yet available on mid-1995 Tri-Cities population, although Hanford Site and total nonfarm employment are on a downward trend as of August 1995 (Schafer 1995).

I.6.1.2 Population by Race and Minority Status

Table I.6.1.1 details the 1990 population for Benton and Franklin counties and for comparison provides Washington State population by race and minority status. The data show that minorities are a smaller percentage of Benton County population than in Franklin County or Washington State. The largest minority group in the Tri-Cities MSA is the Hispanic origin group, which makes up 30.2 percent of the population of Franklin County and 7.7 percent of Benton County. African Americans make up 1 percent of population in Benton County and 3.5 percent of Franklin County's population.

The American Indian, Eskimo, and Aleut category (Native Americans) accounts for less than 1 percent of the population in each county.

Table I.6.1.1 Population by Race and Minority Status, 1990

	Benton County Population	Percent	Franklin County Population	Percent	Washington State Population	Percent
Total Population	112,560	100.0	37,473	100.0	4,866,692	100.0
White	102,832	91.4	26,917	71.8	4,308,937	88.5
African American	1,085	1.0	1,310	3.5	149,801	3.1
American Indian, Eskimo, Aleut	861	0.8	263	0.7	81,483	1.7
Asian and Pacific Islanders	2,246	2.0	869	2.3	210,958	4.3
Other	5,536	4.9	8,114	21.7	115,513	2.4
Hispanic Origin	8,624	7.7	11,316	30.2	214,570	4.4
Minority Group	12,782	11.4	13,689	36.5	645,070	13.3

Notes:

Other is primarily a count of persons who marked Other Race on the Census form.

Hispanic Origin is not a race category and persons of Hispanic origin are counted in the other race categories.

Minority group consists of all races other than white plus whites of Hispanic origin.

Source: WSDS 1993a

I.6.1.3 Urban, Rural, and Farm Populations

Benton County has a higher percentage of its population classified as urban (87.2 percent) than Washington State (76.4 percent) as a whole, while Franklin County has a lower percentage of urban residence (72.7 percent) than Washington State. At the same time, Benton County's farm population is more than twice as large as a percentage of total population than for Washington State as a whole (12.6 percent to 5.5 percent). Franklin County's farm population is almost five times as large on a percentage basis (24.9 percent) as Washington State's farm population. Franklin County's nonfarm rural population makes up 30 percent of the county's total population, which is virtually the same as the State's (29.3 percent), while more than twice the percentage in Benton County (13.0 percent). These data suggest the relative importance of farming in Franklin County and to a lesser extent in Benton County, compared to Washington State as a whole.

I.6.1.4 Minority and Native American Populations

This section and the following section on low-income populations (I.6.1.5) provide data on the distribution of minority, Native American, and low-income populations within an 80 km (50 mi) radius of the Hanford Site, in accordance with the Federal environmental justice policy (EO 12898).

The data provided are based on the following definitions:

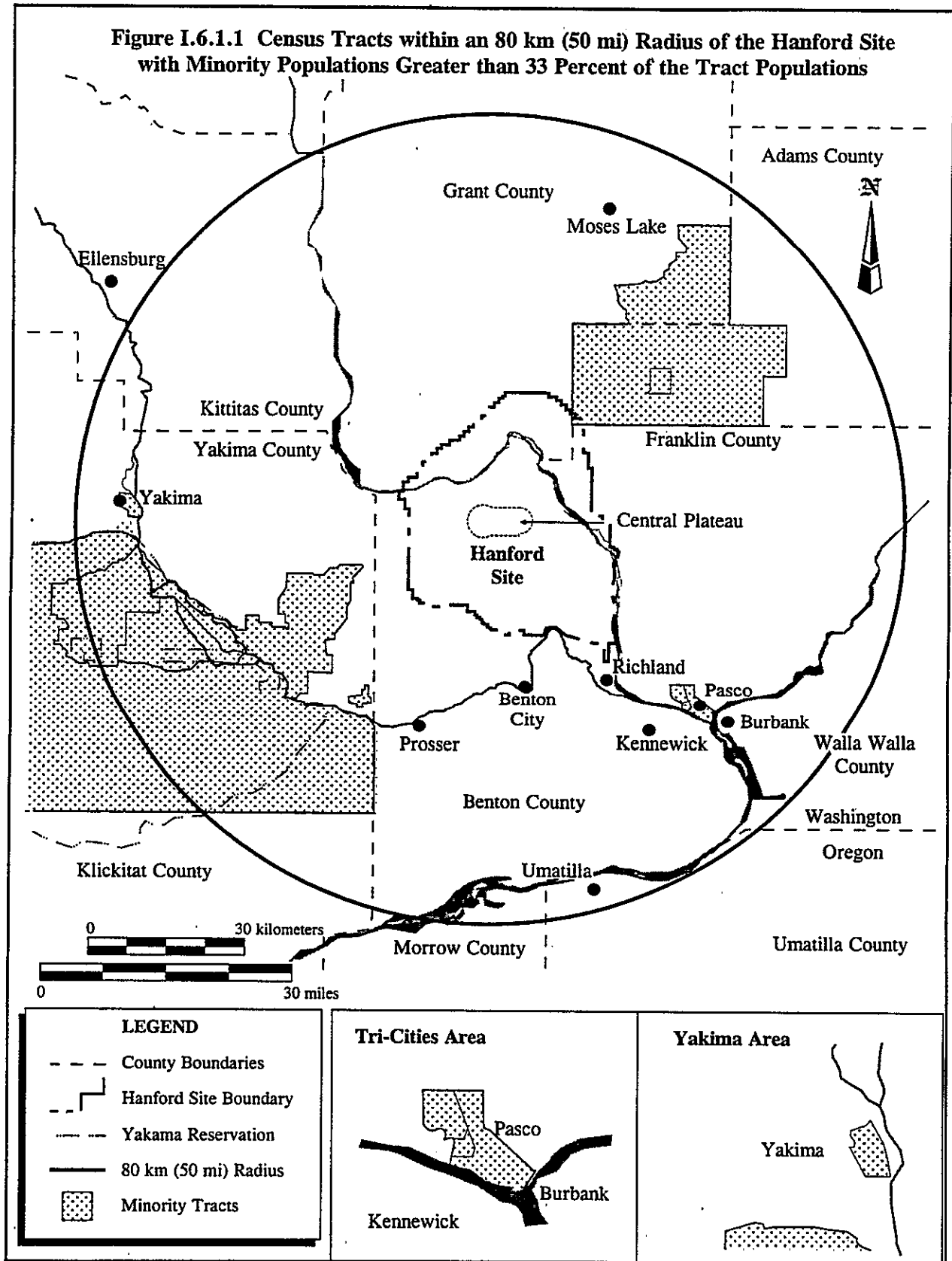
- **Minority and Native American population:** Individuals identified in U.S. Bureau of the Census data for 1990 as Negro, Black or African American, Hispanic, Asian, and

- Pacific Islander, Native American, Eskimo, Aleut, and other non-White persons (DOC 1991). The minority population consists of the number of individuals residing in the 80 km (50 mi) radius of the Hanford Site who are members of a minority group.
- Low-Income population: Individuals identified in the U.S. Bureau of the Census data for 1990 as having incomes at or below 100 percent of the poverty level (DOC 1991). The low-income population consist of the number of individuals residing in the 80 km (50 mi) radius of the Hanford Site who have incomes below the poverty level.
 - Minority and Native American communities and low-income communities: For the purposes of this EIS, minority and Native American and low-income populations were analyzed at the census tract level. All tracts within a 80 km (50 mi) radius of the Hanford Site were included in the analysis. Tracts with a substantial minority or low income population were identified as a community for purposes of environmental justice analysis. The 80 km (50 mi) area of interest was selected based on guidance from DOE regarding the analysis of environmental justice in NEPA documents and is the same area used for the analysis of environmental and human health impacts in other sections of the EIS.

The first step in identifying minority and Native American and low-income communities was to identify the total population of each group within the 80 km (50 mi) radius area of interest. The second step was to identify the combination of census tracts for each type of community that had a total minority and Native American or low-income population that would total one-half of the total population for the entire area of interest.

For minority populations, census tracts with populations that when combined, totaled one-half of the minority and Native American population for the area of interest, had an average percentage of minority and Native American individuals of 33 percent of the tract's total population. These census tracts were then considered minority and Native American communities for the purpose of environmental justice analysis in the EIS (Figure I.6.1.1). For low-income populations, census tracts with populations that when combined totaled one-half of the low-income population for the area of interest, had an average percentage of low-income individuals of 22 percent of the census tract's total population. These census tracts were then considered low-income communities for the purpose of the environment justice analysis in the EIS (Figure I.6.1.2).

The 80 km (50 mi) radius surrounding the Hanford Site's Central Plateau had a total minority and Native American population of 86,415 individuals as of the 1990 Census (Table I.6.1.2). The area's minority and Native American population of 19.3 percent greatly exceeds the Washington State average of 13.1 percent. The Hanford Site region's principal minority groups consist of Hispanics. In 1990, Hispanics comprised approximately 14.3 percent (64,300 individuals) of the area's population. The Hispanic population is relatively dispersed throughout the area, although Adams, Franklin, and Yakima counties in Washington State have relatively higher populations of Hispanic residents than do the other counties in the region. The Native American population of the surrounding area was approximately 2.4 percent (10,800 individuals). The Native American population is disproportionately



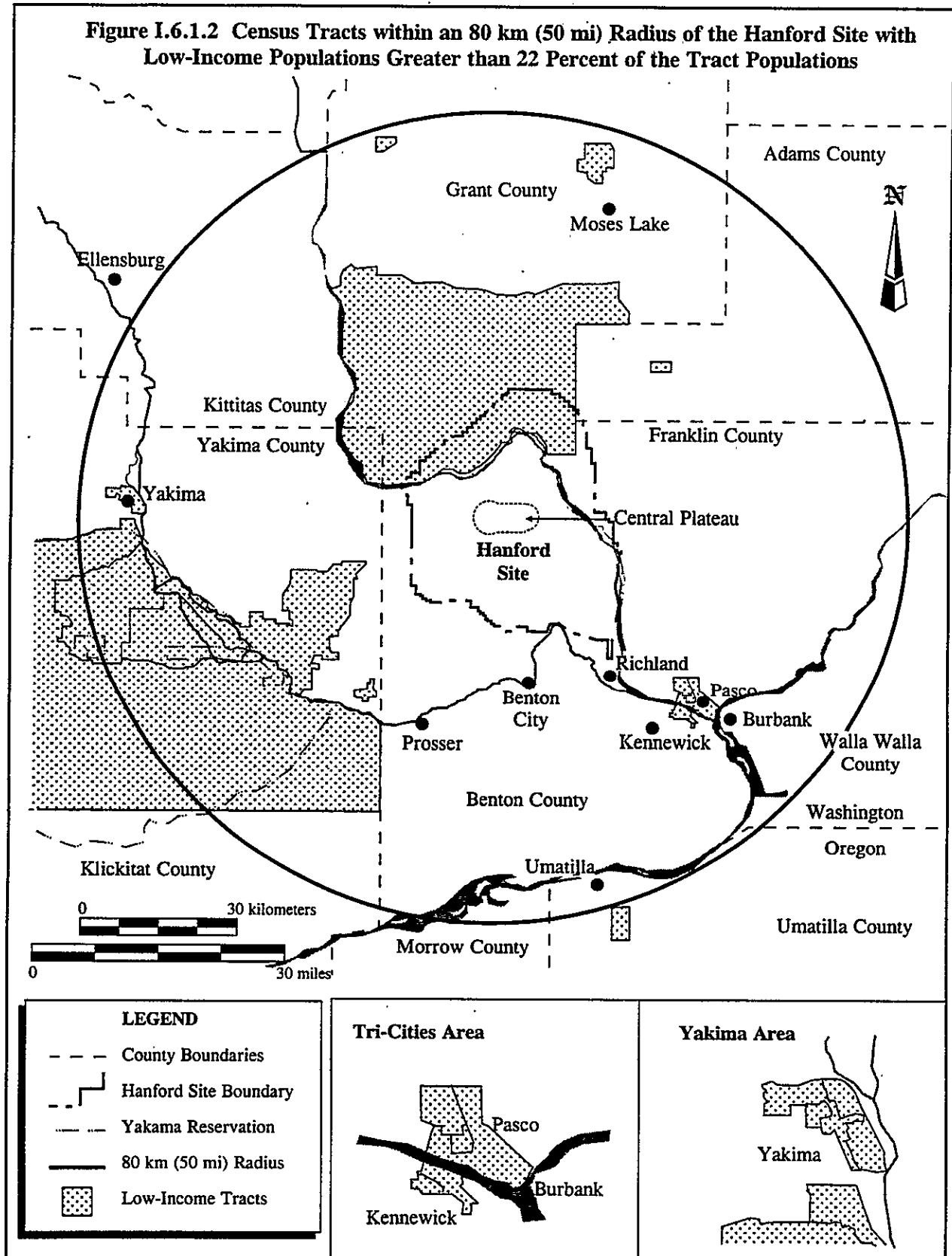


Table I.6.1.2 Minority Populations Within an 80 km (50 mi) Radius of the Hanford Site by County (1990 Census)

County	Total Population	White	African American	Native American, Eskimo, Aleut	Asian and Pacific Islander	Other (Hispanic)	Percent Minority
Adams, WA	11,076	6,630	24	42	84	4,296	40.14%
Benton, WA	112,560	102,832	1,085	861	2,246	5,536	8.64%
Franklin, WA	37,473	26,917	1,310	263	869	8,114	28.17%
Grant, WA	45,549	38,261	544	351	573	5,820	16.00%
Kittitas, WA	7,965	7,695	5	58	49	158	3.39%
Klickitat, WA	6,802	6,243	15	295	51	198	8.22%
Morrow, OR	4,444	3,703	5	58	17	661	16.67%
Umatilla, OR	25,920	22,894	282	380	303	2,061	11.67%
Walla Walla, WA	7,748	7,256	23	41	30	398	6.35%
Yakima, WA	188,823	139,514	1,938	8,405	1,922	37,044	26.11%
Area Total	448,360	361,945	5,231	10,754	6,144	64,286	---
Percent of 80 km (50 mi) Area	100%	80.73%	1.17%	2.39%	1.37%	14.34%	19.27%

Source: DOC 1991

located on the Yakama Indian Reservation, in south-central Washington, with smaller concentrations in Benton and Grant counties in Washington. African American (5,200 or 1.2 percent) and Asian (6,100 or 1.4 percent) populations in 1990 within the surrounding area were very small and located predominantly in Yakima, Benton, and Franklin counties in Washington State.

As of the 1990 census, 17 of the 97 census tracts that are contained completely or partially within the 80 km (50 mi) radius of the Hanford Site had minority or Native American populations that exceeded 33 percent of their total tract populations (Table I.6.1.3).

These 17 census tracts contained less than one in five of the area's total residents, yet approximately 52 percent of the region's total minority or Native American population reside in these tracts. Moreover, in 1990 these 17 census tracts were home to over six in ten of the area's Native American residents and at least 57 percent of the region's Hispanic population. Only four of the ten counties in the area (Yakima, Franklin, Grant, and Adams) have census tracts with high levels of minority or Native American residents compared to the region as a whole. In 1990, Yakima County had ten of the 17 tracts with a 33 percent or greater minority or Native American population. The highest percentage population of minority or Native American residents was found in census tract 0025, located in Yakima County (71.4 percent).

Table I.6.1.3 Census Tracts Within 80 km (50 mi) of the Radius Hanford Site With Minority Populations Greater Than 33 Percent of the Tract Population

County and Census Tract	Total Population	White	African American	Native American, Eskimo, Aleut	Asian/Pacific Islander	Other (Hispanic)	Total Minority	Percent Minority
Adams 9503	4,603	2,527	7	7	6	2,086	2,106	45.46%
Adams 9504	1,932	1,000	5	15	9	903	932	48.24%
Adams 9505	2,750	1,463	11	13	57	1,206	1,287	46.80%
Franklin 0201	3,917	1,404	455	30	20	2,008	2,513	64.16%
Franklin 0202	4,679	2,678	148	46	72	1,735	2,001	42.77%
Franklin 0203	4,172	2,520	188	37	215	1,212	1,652	39.60%
Grant 9813	2,678	1,547	13	12	38	1,068	1,131	42.23%
Yakima 0015	8,032	3,974	656	263	54	3,085	4,058	50.52%
Yakima 0019	7,134	3,943	38	29	58	3,066	3,191	44.73%
Yakima 0020.1	6,679	2,581	17	58	39	3,984	4,098	61.36%
Yakima 0020.2	5,825	3,621	17	43	49	2,095	2,204	37.84%
Yakima 0021	7,085	4,350	9	121	25	2,580	2,735	38.60%
Yakima 0023	7,615	2,745	50	659	26	4,135	4,870	63.95%
Yakima 0024	4,027	1,625	10	1,327	82	983	2,402	59.65%
Yakima 0025	5,360	1,531	20	1,061	169	2,579	3,829	71.44%
Yakima 0026	5,826	2,866	8	1,431	243	1,278	2,960	50.81%
Yakima 0027	6,585	2,372	20	1,647	39	2,507	4,213	63.98%
Total	88,924	42,747	1,672	6,799	1,201	36,510	46,182	51.93%
Percent of 80 km Area	19.83%	11.81%	31.96%	63.22%	19.55%	56.79%	53.44%	

Source: DOC 1991

Geographically, the tracts with disproportionately high minority populations or Native American are located northeast of the Hanford Site in Adams and Grant counties, southeast of the Site in Franklin County, southwest and west of the Site along the Yakima River Valley in Yakima County, and on the Yakama Indian Reservation (Figure I.6.1.1). Of the remaining census tracts, 49 tracts had 1990 minority and Native American populations of less than 10 percent, 23 tracts had minority or Native American populations under 20 percent, and nine tracts had minority and Native American populations of between 21 and 33 percent.

Five census tracts (Table I.6.1.4), all located within the Yakama Indian Reservation in Yakima County, Washington have large Native American populations. In 1990, the population of these tracts contained nearly 57 percent of the 80 km (50 mi) radius area's Native American population. As of 1990, these

Table I.6.1.4 Census Tracts Within 80 km (50 mi) Radius of Hanford with Native American Populations Greater Than 500 Individuals (1990 Census)

County and Census Tract	Total Population	Total Minority Population	Percent Minority	Total Native American, Eskimo, Aleut Population	Percent American Indian, Eskimo, Aleut
Yakima 0023	7,615	4,870	63.95%	659	8.65%
Yakima 0024	4,027	2,402	59.65%	1,327	32.95%
Yakima 0025	5,360	3,829	71.44%	1,061	19.80%
Yakima 0026	5,826	2,960	50.81%	1,431	24.56%
Yakima 0027	6,585	4,213	63.98%	1,647	25.01%
Total	29,413	18,274	63.13%	6,125	20.82%
Percent of 80 Km Area	6.56%	21.15%	N/A	56.96%	N/A

Notes:

N/A = Not Applicable

Source: DOC 1991

tracts were the only census tracts in the area where the Native American population exceeded 8 percent of the tract population.

Census data is an imprecise tool for determining the exact representation of the Hispanic population. Individuals of Hispanic origin derive from diverse cultures and ethnicities. Racial identification is complicated by the lack of a Hispanic category. Hence, Hispanics select from among the available choices of White, African American, American Indian, or Other. Many select Other, although up to four in ten select a different designation, with the bulk selecting White. For the purposes of this report, the census data for the Other category is used to provide an indication of those census tracts that are disproportionately populated by residents of Hispanic origin. Although the Other category does tend to under report the Hispanic population, it provides a tool of sufficient accuracy to approximate Hispanic population concentrations.

All of the 17 census tracts with a minority and Native American population greater than 33 percent had substantial numbers of individuals listed in the Other category (Table I.6.1.5.). In all but three of the tracts, the Other category alone accounted for more than 33 percent of the population of the census tracts. Two of these three tracts are located on the Yakama Indian Reservation and have substantial Native American populations. The third tract is located in Franklin County.

I.6.1.5 Low-Income Populations

Figure I.6.1.2 shows the census tracts within an 80 km (50 mi) radius of the Hanford Site with low-income populations greater than 22 percent of the tract population. The 80 km (50 mi) radius surrounding the Hanford Site had a total low-income population in 1990 of 77,700 (Table I.6.1.6).

Table I.6.1.5 Census Tracts Within 80 km (50 mi) Radius of Hanford With Substantial Other Populations Within a Tract With Greater Than 33 Percent Minority and Native American Population (1990 Census)

County and Census Tract	Total Population	Total Minority and Native American	Percent Minority and Native American	Other (Hispanic)	Percent Other
Adams 9503	4,603	2,106	45.56%	2,086	0.453
Adams 9504	1,932	932	48.24%	903	0.467
Adams 9505	2,750	1,287	46.80%	1,206	0.439
Franklin 0201	3,917	2,513	64.16%	2,008	0.513
Franklin 0202	4,679	2,001	42.77%	1,735	0.371
Franklin 0203	4,172	1,652	39.60%	1,212	0.291
Grant 9813	2,678	1,131	42.23%	1,068	0.399
Yakima 0015	8,032	4,058	50.52%	3,085	0.384
Yakima 0019	7,134	3,191	44.73%	3,066	0.43
Yakima 0020.1	6,679	4,098	61.36%	3,984	0.597
Yakima 0020.2	5,825	2,204	37.84%	2,095	0.36
Yakima 0021	7,085	2,735	38.60%	2,580	0.364
Yakima 0023	7,615	4,870	63.95%	4,135	0.543
Yakima 0024	4,027	2,402	59.65%	983	0.244
Yakima 0025	5,360	3,829	71.44%	2,579	0.481
Yakima 0026	5,826	2,960	50.81%	1,278	0.219
Yakima 0027	6,585	4,213	0.64	2,507	0.381
Total	88,899	46,182	51.93%	36,510	0.411
Percent of 80 Km Area	0.198	53.43%	N/A	56.79%	N/A

Notes:

N/A = Not Applicable

Source: DOC 1991

Table I.6.1.6 Low-Income Population Within an 80 km (50 mi) Radius of the Hanford Site by County (1990 Census)

County	Total Population	Total Poverty Population	Percent Poverty Population
Adams, WA	11,076	1,967	17.76%
Benton, WA	112,560	12,402	11.02%
Franklin, WA	37,473	8,491	22.66%
Grant, WA	45,549	9,403	20.64%
Kittitas, WA	7,965	823	10.33%
Klickitat, WA	6,802	1,197	17.60%
Morrow, OR	4,444	848	19.08%
Umatilla, OR	25,920	4,253	16.41%
Walla Walla, WA	7,748	787	10.16%
Yakima, WA	188,823	37,486	19.85%
Area Total	448,360	77,657	17.32%

Source: DOC 1991

The area's low-income population of 17.3 percent greatly exceeded the Washington State average of 10.9 percent. In counties examined within Washington, only Walla Walla, Kittitas, and Benton counties had low-income populations below or slightly above the State-wide average.

All of the remaining counties had low-income populations exceeding the 17.3 percent region average. Franklin County, Washington had a low-income population more than double the State-wide average.

In all, 25 of the 97 census tracts that are contained all or in part within the 80 km (50 mi) radius of the Hanford Site had low-income populations in 1990 greater than 22 percent of their total populations (Table I.6.1.7). These 25 census tracts contained less than three in ten of the area's total residents (27.9 percent), yet, more than half of the region's total low-income population lived in these tracts (50.8 percent). All but four of the counties, Walla Walla, Kittitas, and Klickitat in Washington, and Morrow County, Oregon, had at least one census tract containing at least 22 percent of the low-income population. Adams and Benton Counties in Washington, and Umatilla County, Oregon, had two or fewer census tracts with low-income populations greater than 22 percent.

Yakima County had four of the five tracts with 22 percent or greater low-income population in 1990. The highest percentage population of low-income residents was found in census tract 0001, located in Yakima County (45.4 percent). The 25 tracts had a total average low-income population of more than 31.5 percent. Geographically, the tracts with large, low-income populations (22 percent or greater) are located north and northeast of the Hanford Site in Grant County, southeast of the Site in Franklin County, and southwest and west of the Site along the Yakima River Valley and on the Yakama Indian Reservation in Yakima County (Figure I.6.1.2).

Table I.6.1.7 Census Tracts Within 80 km (50 mi) Radius of the Hanford Site With Low-Income Populations Greater Than 22 Percent of the Population (1990 Census)

County and Census Tract	Total Population	Poverty Population	Percent Poverty Population
Adams 9504	1,932	630	32.61
Benton 112	5,479	1,589	29.00
Benton 113	4,118	912	22.15
Franklin 0201	3,917	1,685	43.02
Franklin 0202	4,679	1,748	37.36
Franklin 0203	4,172	1,150	27.56
Franklin 0204	6,351	1,911	30.09
Grant 9806	3,870	1,161	30.00
Grant 9808	3,806	1,384	36.36
Grant 9814	6,101	1,579	25.88
Umatilla 9512	5,757	1,301	22.60
Yakima 0001	2,430	1,102	45.35
Yakima 0002	4,217	1,677	39.77
Yakima 0003	2,903	650	22.39
Yakima 0006	4,598	1,743	37.91
Yakima 0013	2,269	527	23.23
Yakima 0015	8,032	3,524	43.87
Yakima 0019	7,134	1,983	27.80
Yakima 0020.1	6,679	2,079	31.13
Yakima 0021	7,085	1,692	23.88
Yakima 0023	7,615	2,139	28.09
Yakima 0024	4,027	1,594	39.58
Yakima 0025	5,360	1,692	31.57
Yakima 0026	5,826	1,562	26.81
Yakima 0027	6,585	2,497	37.92
Area Total	124,942	39,411	31.54
Percent of 80 Km Area	27.87%	50.75%	17.32

Source: DOC 1991

Of the remaining census tracts, 30 tracts had 1990 low-income populations that are less than the Washington State average (10.9 percent), 27 tracts had low-income populations between 11 percent and the average low-income population level of 17.3 percent of the 80 km (50 mi) area, and 15 tracts had low-income populations between 17.3 and 22 percent. Fourteen of the 30 census tracts with low-income populations under the Washington State average are located in Benton County (12 tracts) or in the two Franklin County tracts located closest to Hanford Site transportation access.

I.6.1.6 Household Income

The largest fraction of Franklin County households is in the \$15,000 to \$24,999 income range (Table I.6.1.8). Benton County has its highest concentration of households in the \$35,000 to \$49,999 range, as does Washington State as a whole. Benton County incomes are slightly skewed to the higher household income ranges as compared to incomes in Washington State as a whole, while Franklin County incomes are skewed to the lower income ranges. Median household income in Benton County was \$32,593 in 1990, while per capita income was \$14,027. Median household income in Franklin County was \$24,604 in 1990, while per capita income was \$10,407. In 1990, Washington State median household income was \$31,183, while per capita income was \$14,923.

Data on persons and families below the poverty level show that for most categories Benton County has the same or slightly higher poverty rates as Washington State (11.1 percent compared to 10.9 percent). In contrast, Franklin County's 23 percent poverty rate is substantially higher than the poverty rates for Washington State and Benton County (Table I.6.1.9). The data on income reflect overall the greater urbanization of Benton County and the effects of the Hanford Site as a large source of specialized technical and professional employment in Benton County.

I.6.1.7 Educational Attainment

Benton County residents have approximately the same level of education as residents State-wide while Franklin County residents tend to have a lower level of educational attainment (Table I.6.1.10).

I.6.2 PUBLIC FACILITIES AND SERVICES

The following sections describe public facilities and service systems in the Tri-Cities that potentially could be impacted by implementation of the EIS alternatives. Discussions are provided for public safety, hospitals, electricity and natural gas, sewer, and solid waste. Water supply systems are discussed in Section I.2.3.

I.6.2.1 Public Safety

Public safety services, including police and fire, are provided by a number of jurisdictions in the region. Police protection is provided by the county sheriff departments of Benton and Franklin counties, local municipal police departments (Pasco, Richland, and Kennewick), and the Washington State Patrol Division in Kennewick. In terms of total staffing, the local municipal police departments (162 commissioned officers and 79 reserve officers) are considerably larger than the two county sheriff departments, which had 64 commissioned officers and 35 reserve officers in 1994 (Cushing 1995).

Table I.6.1.8 Household Income, 1990

Income Category	Number of Households		
	Benton County	Franklin County	Washington State
Total Households	42,384	12,248	1,875,508
Less than \$5,000	1,695	1,017	85,161
\$5,000 to \$9,999	3,662	1,420	157,317
\$10,000 to \$14,999	3,586	1,301	158,603
\$15,000 to \$24,999	7,177	2,485	335,204
\$25,000 to \$34,999	6,568	2,066	315,994
\$35,000 to \$49,999	8,833	1,824	367,466
\$50,000 to \$74,999	7,527	1,474	296,969
\$75,000 to \$99,999	2,290	372	90,290
\$100,000 to \$149,999	891	180	44,692
\$150,000 or more	155	109	23,812
Income Category	Percent of Households		
	Benton County	Franklin County	Washington State
Less than \$5,000	4.00	8.30	4.54
\$5,000 to \$9,999	8.64	11.59	8.39
\$10,000 to \$14,999	8.46	10.62	8.46
\$15,000 to \$24,999	16.93	20.29	17.87
\$25,000 to \$34,999	15.50	16.87	16.85
\$35,000 to \$49,999	20.84	14.89	19.59
\$50,000 to \$74,999	17.76	12.03	15.83
\$75,000 to \$99,999	5.40	3.04	4.81
\$100,000 to \$149,999	2.10	1.47	2.38
\$150,000 or more	0.37	0.89	1.27

Source: DOC 1991

Table I.6.1.9 Persons and Families Below Poverty Level, 1990

Category	Percent Below Poverty Level		
	Benton County	Franklin County	Washington State
All Persons	11.1	23.0	10.9
Persons 18 Years and Over	9.5	18.8	9.7
Persons 65 Years and Over	9.1	11.4	9.1
Related Children Under 18 Years	14.4	30.4	14.0
Related Children Under 5 Years	17.8	37.2	17.0
Related Children 5 to 17 Years	13.1	27.8	12.8
Unrelated Individuals	21.9	35.7	21.9
All Families	8.9	18.4	7.8
With Related Children Under 18 Years	13.5	26.0	12.3
With Related Children Under 5 Years	17.7	34.0	15.8
Female Householder Families	38.1	51.4	30.1
With Related Children Under 18 Years	46.1	66.1	39.5
With Related Children Under 5 Years	59.0	79.2	57.5

Source: DOC 1991

Table I.6.1.10' Educational Attainment, 1990

Category	Benton County	Franklin County	Washington State
Persons 25 Years and Older	69,511	20,795	3,126,390
Educational Attainment	Persons 25 Years or Older		
Less than 9th Grade	4,263	3,760	171,311
9th to 12th Grade, No Diploma	6,942	2,871	334,472
High School Graduate	19,221	5,904	873,150
Some College, No Degree	16,877	3,845	782,010
Associate's Degree	6,015	1,628	248,478
Bachelor's Degree	10,770	2,073	496,866
Graduate or Professional Degree 9	5,423	714	220,103
Educational Attainment	Percent of Persons 25 Years or Older		
Less than 9th Grade	6.1	18.1	5.5
9th to 12th Grade, No Diploma	10.0	13.8	10.7
High School Graduate	27.7	28.4	27.9
Some College, No Degree	24.3	18.5	25.0
Associate's Degree	8.7	7.8	7.9
Bachelor's Degree	15.5	10.0	15.9
Graduate or Professional Degree	7.8	3.4	7.0
Percent High School Graduate or Higher	83.9	68.1	83.8
Percent Bachelor's or Higher Degree	23.3	13.4	22.9

Source: DOC 1991

Fire protection in the Tri-Cities area is provided by fire departments in the cities of Kennewick, Pasco, and Richland, a volunteer fire department in West Richland, and three rural fire departments in Benton County.

Public safety services are also provided at the Hanford Site. In the past the Hanford Patrol has provided security and law enforcement services for the Site. Currently, the Benton County Sheriff's Department is providing law enforcement support. The Sheriff's Department maintains an office in the 300 Area. The Hanford Fire Department has approximately 125 firefighters who are trained to dispose of hazardous waste and fight chemical fires. The Hanford Fire Department has fire stations in the 100, 200, 300, 400, and 1100 Areas of the Hanford Site.

I.6.2.2 Hospitals

There are three large hospitals and four small emergency centers in the Tri-Cities area. Kadlec Medical Center in Richland has 144 beds, approximately 5,600 annual admissions, and operates at 45 percent capacity (Cushing 1995). Kennewick General Hospital has 70 beds, 4,700 annual

admissions, and operates at approximately 46 percent capacity (Cushing 1995). Our Lady of Lourdes Hospital in Pasco had over 4,400 admissions in 1994 (Cushing 1995).

While the Hanford Environmental Health Foundation is primarily involved in performing risk-management services for the Site, they also provide health screening for workers and respond to emergencies at the Site. The Hanford Environmental Health Foundation currently operates five onsite health service centers including facilities in the 100, 200 East, 200 West, and 300 Areas.

1.6.2.3 Schools

Educational services at the primary and secondary level are provided by four school districts. Kennewick is the largest district, serving approximately 13,000 students in 1994, with nearly 8,700 students in the Richland district, 7,800 students in the Pasco district, and 1,500 students in the Kiona-Benton district (Cushing 1995).

School enrollment has increased over the last few years, with all four school districts operating at or near their capacity during the 1994 school year (Cushing 1995). Despite declining Hanford Site employment, school enrollment in the 1995 school year increased by the following approximate amounts: Richland 0.9 percent; Pasco 1.1 percent; Kennewick 2.6 percent; and Kiona-Benton 5.1 percent (Brown 1995, Foley 1995, Haun 1995, Marsh 1995, Meilour 1995, O'Neil 1995). Portable classrooms are used in the Richland (20 portables) and Pasco (60 portables) school districts.

Post-secondary education in the area is provided by the Columbia Basin Community College and the Tri-Cities branch campus of Washington State University. The fall 1994 enrollments for these schools were approximately 6,800 and 1,300, respectively (Cushing 1995).

1.6.2.4 Electricity and Natural Gas

Electricity in the Tri-Cities is provided by the Benton County Public Utility District, Benton Rural Electrical Association, Franklin County Utility District, and the City of Richland Energy Services Department. The Bonneville Power Administration, a Federal power marketing agency, supplies all the power that these utilities provide in the local area.

Electrical power for the Hanford Site is purchased wholesale from the Bonneville Power Administration. The Hanford Site electrical distribution system is used to distribute power to the majority of the Site. The city of Richland distributes power to the 700, 1100, and 3000 Areas. This is approximately 2 percent of the total Hanford Site usage. Energy requirements for the Hanford Site exceeded 550 MW during fiscal year 1988 (Cushing 1994). The Site's electrical requirement in 1993 was substantially lower at approximately 57 MW (Cushing 1994).

Natural gas, provided by the Cascade Natural Gas Corporation, serves a small portion of the region's residents. In December 1993, Cascade Natural Gas Corporation had approximately 5,800 residential customers (Cushing 1994).

Hydroelectric, coal, nuclear power, oil, and natural gas fuel the Pacific Northwest's electrical generation system. Hydroelectricity is the primary power source in the region, accounting for approximately 74 percent of the region's installed generating capacity of 40,270 MW, and supplying approximately 56 percent of the electricity used by the region. Coal provides 16 percent of the region's electrical generating capacity (Cushing 1994). The one operating commercial nuclear power plant in the Pacific Northwest (located on the Hanford Site) provides approximately 6 percent of the region's generating capacity.

Throughout the 1980's and into the 1990's, the Pacific Northwest has had more electric power than it required. Hydroelectric power improvement projects currently under construction would provide about 150 MW of new capacity (Cushing 1994).

I.6.2.5 Sewer

Sanitary wastes in the 200 Areas are currently disposed of through septic tanks and drain fields. There are concerns about the ability of the current system to handle projected sanitary waste disposal needs resulting from new facilities, increased personnel, and changing environmental regulations. The planned construction of a central collection and treatment facility in the 200 Areas was canceled due to funding constraints. Future upgrades to 200 Area septic systems may be needed to meet capacity and regulatory requirements (Harvey 1995a).

The major incorporated areas of Benton and Franklin counties are served by municipal wastewater treatment systems and the unincorporated areas are served by onsite septic systems. The city of Richland's wastewater treatment system is designed to treat a total capacity of $1.1\text{E}+8$ L (30 million gal) per day. The Richland system processed an average of $7.1\text{E}+7$ L (17 million gal) per day in 1994 (Cushing 1995). The wastewater treatment system for the city of Kennewick is also operating well below capacity. The Kennewick system has a treatment capacity of $8.3\text{E}+7$ L (22 million gal) per day. In 1994 the Kennewick system processed an average of $4.0\text{E}+7$ L (10.6 million gal) per day. The Pasco wastewater treatment system has the capacity to treat $9.5\text{E}+7$ L (25 million gal) per day, and currently processes an average of $2.3\text{E}+7$ L (6.2 million gal) per day (Cushing 1995).

I.6.2.6 Solid Waste

The existing Hanford Site nonradioactive solid waste landfill is expected to reach its capacity in 1996. In October 1995 it was announced that DOE and the city of Richland reached an agreement to send the Site's nonregulated and nonradioactive solid waste to the Richland Sanitary Landfill (DOE 1995k).

The city-operated Richland Sanitary Landfill serves Benton County. The landfill, which receives about 200 tons of solid waste per day, has a current life expectancy of 50 years (Penour 1994). This could be extended to approximately 100 years with design modifications.

The city of Kennewick has a contract with Waste Management of Kennewick for solid waste disposal. Waste Management disposes of the solid waste at the Columbia Ridge Landfill in Arlington, Oregon, a facility with a life expectancy of approximately 50 years (Denley 1994).

The cities of Pasco and West Richland have contracts with Basin Disposal, Inc. for solid waste disposal. Basin Disposal, Inc. disposes of the solid waste at the Roosevelt Regional Landfill in Roosevelt, Washington, a facility with a life expectancy of approximately 40 years (Thiele 1995).

I.6.3 ECONOMY

Because the Hanford Site is the largest employer in the Tri-Cities area, it is a key factor in the local economy. In 1994, total nonfarm employment in the area averaged about 72,300. During the same period, Hanford Site employment was about 18,400 or approximately 25 percent of total nonfarm employment. In addition, other workers who are not included in the data as Hanford Site employees provide goods and services to the Hanford Site or its contractors. Agriculture, food processing, retail trade, and other industries provide substantial economic diversity to the MSA.

Farm employment averaged about 3,500 jobs in Franklin County in 1992 and 4,200 jobs in Benton County. However, Franklin County farm employment ranged from a high of about 9,000 in June 1992 to a low of 1,100 in January. The range in Benton County was 10,700 in June to 1,900 in December. This range reflects the seasonal nature of farm labor. In addition, many farm workers are migratory workers who come to the area during harvest seasons then move on to other regions. Also, year-to-year changes in farm employment are subject to random variations in weather and agricultural market conditions. Changes in Hanford Site employment do not impact the area's farm employment, and for this reason the following discussion focuses on nonfarm employment only.

I.6.3.1 Industries and Employment

Beside DOE and the Hanford Site contractors, major employers in the Tri-Cities MSA include Siemens Nuclear Power Corporation, Sandvik Special Metals, Burlington Northern Railroad, and the Washington Public Power Supply System. Two other major employers, Iowa Beef Processors and Boise-Cascade, have facilities in Walla Walla County adjacent to Franklin County with many of their employees living and shopping in the Tri-Cities (Cushing 1994).

Table I.6.3.1 shows average annual employment by sector in 1993. The largest sector is services, which includes business services, research services (including most Hanford Site employees), and other services. Other Hanford Site employees are classified in the construction, health services, and business services sectors.

Total nonfarm employment was approximately 72,300 in 1994, compared to 70,000 in 1993. As of August 1995, nonfarm employment in the Tri-Cities was approximately 70,900. Although detailed data by employment sector are not yet available, declines were noted in the construction sector because of the decline in housing starts and in the services sector because of Hanford Site employment reductions (Schafer 1995).

Table I.6.3.1 Average Annual Employment by Sector Richland-Kennewick-Pasco MSA, 1993

Industry	Annual Average Employment	Percent of Total
Total Manufacturing	5,600	8
Food Processing	3,000	-4.3
Printing and Publishing	400	-0.6
Chemicals	1,100	-1.6
Metal	400	(0.6)
Other	800	(1.1)
Construction	3,900	5.6
Transport and Public Utilities	2,200	3.1
Wholesale and Retail Trade	14,000	20.0
Finance, Insurance, Real Estate	2,100	3.0
Total Services	28,900	41.3
Business Services	2,700	-3.9
Research Services	16,100	-23
Other Services	10,100	(14.4)
Government	12,900	18.4
Total	70,000	100

Notes:

1994 nonfarm employment was 72,300; August 1995 nonfarm employment was 70,900.

Totals may not equal sum of components because of rounding.

Source: WSDS 1990-95

After services, the next largest sector is wholesale and retail trade. The Tri-Cities MSA is the main retailing sector for southeastern Washington State and northeastern Oregon. A number of national retail chains have opened outlets in the MSA in the last few years. Columbia Center in Kennewick is the primary regional shopping mall (Serot 1993).

Government is the third largest sector, including Federal, State, and local governments and public schools. Construction has been a key sector in the past few years because of new housing construction, commercial construction, and construction at the Hanford Site. Food processing is the largest manufacturing industry, followed by chemicals. The services sector in Benton County, which includes most Hanford Site and Hanford-related employment, dominates the economy in the Tri-Cities MSA. The services sector in Benton County accounted for \$769 million in wages, or about 43 percent of wages paid in the two counties (Table I.6.3.2). State-wide, services accounted for only 21 percent of wages paid. The average wage in the services sector in Benton County was more than \$34,000, compared to \$17,000 in Franklin County and \$23,000 statewide. The higher wage in the services sector in Benton County reflects the specialized technical and professional work force at the Hanford Site.

Table I.6.3.2 Average Wage by Industry in Benton and Franklin Counties and Washington State, 1992

Industry	Average Annual Employment	Total Wages Paid	Average Wage	Percent of Total Wages
Benton County				
Agriculture, Forestry, and Fisheries	4,810	\$48,117,451	\$10,004	3.3
Construction	3,164	\$95,867,883	\$30,300	6.5
Manufacturing	4,047	\$126,619,073	\$31,287	8.6
Transportation and Public Utilities	972	\$26,037,160	\$26,787	1.8
Wholesale and Retail Trade	8,370	\$98,943,546	\$11,821	6.7
Finance, Insurance, and Real Estate	1,418	\$27,715,085	\$19,545	1.9
Services	22,458	\$768,781,080	\$34,232	52.2
Government - Federal	731	\$32,325,298	\$44,221	2.2
State	664	\$16,387,481	\$24,680	1.1
Local	7,304	\$230,961,237	\$31,621	15.7
Totals	53,938	\$1,471,755,294	\$27,286	100
Franklin County				
Agriculture, Forestry, and Fisheries	4,251	\$41,702,173	\$9,810	13.0
Construction	702	\$17,668,957	\$25,169	5.5
Manufacturing	1,379	\$29,379,341	\$21,305	9.2
Transportation and Public Utilities	670	\$16,028,222	\$23,923	5
Wholesale and Retail Trade	4,087	\$70,577,741	\$17,269	22.1
Finance, Insurance, and Real Estate	362	\$6,959,507	\$19,225	2.2
Services	2,960	\$51,110,754	\$17,267	16
Government - Federal	452	\$15,712,451	\$34,762	4.9
State	845	\$21,854,511	\$25,863	6.8
Local	2,179	\$49,062,133	\$22,516	15.3
Totals	17,887	\$320,055,790	\$17,893	100
Washington State				
Agriculture, Forestry, and Fisheries	83,765	\$1,125,052,045	\$13,431	2
Construction	112,788	\$3,134,818,800	\$27,794	5.6
Manufacturing	342,768	\$12,049,035,758	\$35,152	21.4
Transportation and Public Utilities	106,851	\$3,398,023,528	\$31,802	6
Wholesale and Retail Trade	527,051	\$9,607,280,153	\$18,228	17.1
Finance, Insurance, and Real Estate	116,815	\$3,506,125,264	\$30,014	6.2
Services	511,417	\$11,887,196,603	\$23,244	21.2
Government - Federal	73,320	\$2,445,421,381	\$33,353	4.4
State	102,901	\$3,055,252,305	\$29,691	5.4
Local	224,660	\$5,970,628,731	\$26,576	10.6
Totals	2,202,336	\$56,178,834,568	\$25,509	100

Source: WSDS 1993b

Average wages were higher in Benton County than in Franklin County except in the wholesale and retail trade sector. In that sector, Franklin County has more wholesale trade, which typically pays higher wages than retail trade. Also, agriculture is a larger share of Franklin County's economy than Benton County's, although Benton County had a somewhat higher level of wages paid.

I.6.3.2 Labor Force

Data on occupations for 1990 show that the Benton County labor force is concentrated in the managerial and professional and the technical, sales, and administrative occupations, each of which accounts for about 30 percent of the work force (Table I.6.3.3). Franklin County has much lower percentages in these categories. Technical occupations and farming, forestry, and fishing (agricultural) occupations each accounts for about 21 percent of the Franklin County labor force. Franklin County also has a higher percentage of workers in the operators, fabricators, and laborers occupational category (17.3 percent) than Benton County (12.0 percent).

Hispanics account for 6.9 percent of the Benton County labor force, and 46.3 percent of the workers in the agricultural occupational category (Table I.6.3.3). In Franklin County, Hispanics are 28.3 percent of the labor force and 63.2 percent of the workers in the agricultural occupations. At the same time, Hispanics in Franklin County account for over 37 percent of the operators category and almost 28 percent of the precision production, craft, and repair occupations. In Benton County, Hispanics represent about 6 percent of the production occupations and 12 percent of the operators' occupations. Among other non-Hispanic minority groups, the agriculture occupations have the smallest representation.

African Americans, who make up 0.9 percent of the labor force in Benton County, account for 1.4 percent of the managerial occupations, while in Franklin County African Americans account for 2.1 percent of the labor force and 2 percent of the managerial occupations. In Benton County, Native Americans account for a larger percentage of the production and operators than their percentage of the total labor force. In Franklin County, Native Americans account for a larger percentage of the managerial and production occupations than of the total labor force.

Asians and Pacific Islanders account for 2 percent of the labor force in Benton County and 2.7 percent of the managerial occupations. The same group accounts for 2 percent of the labor force in Franklin County but only 1.2 percent of the managerial occupations. Service occupations show the highest rate of Asian and Pacific Islander representation in both counties. Women account for 40.4 percent of the labor force in Benton County and 42.7 percent in Franklin county. Women account for 51.5 percent of the managerial and professional occupations in Benton County and 39.4 percent in Franklin County. In the other occupational categories the representation of women is similar or virtually the same in the two counties.

Table I.6.3.3 Civilian Labor Force by Occupation Group, Sex, Race, and Hispanic Origin, 1990

Category	Total	Female Percent	Non-Hispanic				Hispanic Percent
			African American Percent	Native American Percent	Asian Percent	Other Percent	
Benton County							
Civilian Labor Force 16 Years and Older	55,842	42.7	0.9	0.7	2.0	0.0	6.9
Managerial and Professional Specialty Occupations	16,581	39.4	1.4	0.4	2.7	0.1	2.2
Technical, Sales, and Administrative Support Occupations	16,709	63.0	0.6	0.6	1.3	0.0	3.5
Service Occupations	7,089	56.5	0.7	1.3	3.5	0.0	7.6
Farming, Forestry, and Fishing Occupations	2,536	20.5	0.2	0.0	0.2	0.0	46.3
Precision Production, Craft, and Repair Occupations	6,006	7.7	0.8	1.1	1.2	0.0	5.9
Operators, Fabricators, and Laborers Occupations	6,680	24.4	1.0	1.2	1.9	0.0	11.9
Experienced Unemployed Not Classified by Occupation	241	77.2	0.0	0.0	5.8	0.0	12.0
Franklin County							
Civilian Labor Force 16 Years and Older	17,090	40.4	2.1	0.8	2.0	0.1	28.3
Managerial and Professional Specialty Occupations	2,975	51.5	2.0	1.1	1.2	0.1	7.2
Technical, Sales, and Administrative Support Occupations	3,627	65.3	3.4	1.0	0.5	0.1	9.8
Service Occupations	2,114	56.5	3.0	0.7	5.4	0.0	18.4
Farming, Forestry, and Fishing Occupations	3,510	20.0	0.4	0.4	0.4	0.0	63.2
Precision Production, Craft, and Repair Occupations	1,799	10.6	2.1	1.5	2.0	0.0	27.6
Operators, Fabricators, and Laborers Occupations	2,954	28.5	1.9	0.4	4.1	0.5	37.3
Experienced Unemployed Not Classified by Occupation	111	61.3	9.9	0.0	0.0	0.0	57.7

Source: WSDS 1993a

In terms of the Hanford Site (Table I.6.3.4), the Hanford Site's maintenance and operators contractor's work force is approximately 29 percent female, 4 percent Hispanic, 3 percent African American, 2 percent Asian, and 1 percent Native American (Pitcher 1994).

Table I.6.3.4 Hanford Site Maintenance and Operations Contractor Workforce Representation by Gender and Ethnic Group, 1994

Occupational Category	Total Percent	Female Percent	African American Percent	Hispanic Percent	Asian Percent	Native American Percent
Managers	13	10	2	2	2	0
Exempt, Nonmanagement	49	25	3	3	3	1
Technicians	3	23	2	5	2	1
Clerks and Secretaries	10	96	3	5	1	1
Crafts (skilled)	15	18	3	6	0	1
Operations (semi-skilled)	8	24	1	7	0	2
Service (fire protection)	3	5	3	8	0	2
Percent of Total Labor Force:	100	29	3	4	2	1

Source: Pitcher 1994

I.6.3.3 Tax Base

Local government revenues in Benton and Franklin counties come primarily from property taxes and the local share of sales taxes. Other revenues come from fees, fines, forfeitures, and transfers from the State or the Federal government. In 1993, assessed property values were about \$3.8 billion in Benton County and \$1.3 billion in Franklin County. These assessed values were \$500 million more than 1992 assessments in Benton County (15 percent increase) and \$86 million more in Franklin County (7 percent increase). These increases reflect both new residential and commercial construction and increasing property values caused by the increased demand for residential and commercial property (Serot 1993).

In 1992, the last year for which complete data are available, taxable retail sales for Benton County were \$1,054 million and \$400 million for Franklin County. This represents a 14 percent increase for Benton County from 1991 levels and a 16 percent increase for Franklin County. Between 1988 and 1992, combined taxable retail sales for the two counties increased from \$992 million to \$1,481 million (WSDR 1987-1995). This represents almost a 50 percent increase or about 10.5 percent per year. The increase in taxable retail sales shows the effects of rising employment (leading to more consumer spending), population growth, and a general increase in economic activity (Serot 1993).

I.6.3.4 Housing

The growth in employment and population in the Tri-Cities MSA in the late 1980's and early 1990's created a tight housing market. Between 1988 and 1993, the average price of a single-family home increased from approximately \$59,000 to \$107,000. This increase occurred despite record levels of housing construction. Housing starts increased from 42 in 1988 to 1,200 in 1993 (Table I.6.3.5). However, recent declines in Hanford Site employment, as well as continued construction, have resulted in a softening of the housing market and a decline in housing prices and housing starts in 1995 (TAR 1980-1995). The average home sale price in August 1995 was about \$101,000, down from

Table I.6.3.5 Tri-Cities MSA Home Prices and Housing Starts, 1980 to 1993

Year	Average Selling Price (\$1,000)	New Home Starts
1980	65.1	429
1981	73.1	459
1982	66.8	141
1983	64.8	129
1984	62.6	100
1985	60.9	95
1986	60.0	155
1987	59.6	110
1988	58.8	42
1989	59.7	164
1990	68.3	414
1991	78.7	460
1992	93.8	911
1993	106.6	1,200

Source: TAR 1980-1995, HBA 1980-1994.

about \$126,000 in August 1994. However, most of the drop in home prices occurred in the upper prices ranges, with sales remaining strong in the \$70,000 to \$120,000 range. In September 1995, the Tri-City Association of Realtors described the local housing market as healthy (Schafer 1995).

Housing prices and housing starts in the Tri-Cities MSA have responded to changes in economic conditions during the past 15 years. Home prices declined after the termination of the Washington Public Power Supply System construction project in 1982 and then again after the shut-down of the Hanford Site's last production reactor in 1987. However, the Hanford Site cleanup and environmental restoration mission and increasing staffing levels, as well as growth in other sectors of the economy caused housing prices to increase dramatically. Until recently, despite new construction and new residences, first-time home buyers faced both rising prices and the lack of available housing, especially at the lower end of the price spectrum.

The housing problem was compounded by very low vacancy rates and increasing rents in rental housing, although vacancy rates increased in 1995 (Sivula 1995). A December 1993 survey of apartment complexes in Richland, Kennewick, Pasco, and West Richland showed vacancy rates between 1.0 and 2.3 percent. Overall Tri-Cities housing occupancy rates (both single-family and multiple-unit housing) were approximately 95 percent in 1994 (Cushing 1995).

I.7.0 LAND USE

While the focus in the following land-use section is on the 200 Areas, a brief summary is provided on land uses for the remainder of the Hanford Site as well as surrounding offsite land-use patterns. Also addressed are the future planning efforts of other Federal and State agencies, Tribes, and local governments. Prime and unique farmlands and recreational opportunities also are identified.

I.7.1 PRIME AND UNIQUE FARMLAND

The Farmland Protection Policy Act (FPPA) requires Federal agencies to consider prime or unique farmlands when planning major projects and programs on Federal lands. Federal agencies are required to use prime and unique farmland criteria developed by the U.S. Department of Agriculture's Soil Conservation Service (SCS). Under Farmland Protection Policy Act, the SCS is authorized to maintain an inventory of prime and unique farmlands in the United States to identify the location and extent of rural lands important in the production of food, fiber, forage, and oilseed crops (7 CFR Part 657). The SCS has determined that because of low annual precipitation in southeast Washington State, none of the soil occurring on the Hanford Site would meet prime and unique farmland criteria unless irrigated (Brincken 1994). The specific location of potential irrigable prime or unique farmlands at the Hanford Site has not been determined by the SCS because of the absence of detailed slope information.

I.7.2 EXISTING LAND-USE TYPES AND LAND-USE PLANS

This section discusses 1) existing Site land uses and associated issues based on the Hanford Site Development Plan (HSDP); 2) the Comprehensive Land Use Plan (CLUP) for the Site that is being prepared by DOE, and other relevant land-use plans by Federal, State, and local agencies and Tribal Nations; and 3) recreational uses.

I.7.2.1 Hanford Site Development Plan

The HSDP provides an overview of land use, infrastructure, and facility requirements to support DOE at the Hanford Site (DOE 1993e). Although the HSDP is not a formal land use plan, it is the most current available planning document until the Site's CLUP is issued. DOE has invited Native American Tribes, county and city governments, and other stakeholders to participate in the planning process. A draft of the CLUP is scheduled for release in early 1996. Because the CLUP is not yet available, the following discussion focuses on the HSDP.

The HSDP has a Master Plan section that outlines the future land and the infrastructure needed by Hanford Site missions. The primary objective of the Master Plan has been to develop and maintain the Hanford Site infrastructure to meet ongoing and future program requirements (DOE 1993e). A goal of the HSDP has been to maximize the amount of land available for other beneficial uses, including protecting cultural and biological resources.

The HSDP provides for a compatible land-use transition from passive offsite agricultural uses in Adams, Grant, Franklin, and Benton counties to passive uses onsite in the FEALE Reserve and the proposed National Wildlife Refuge north of and along the Columbia River. The areas of the Hanford Site nearest to the river are proposed to remain undeveloped, providing an additional buffer area

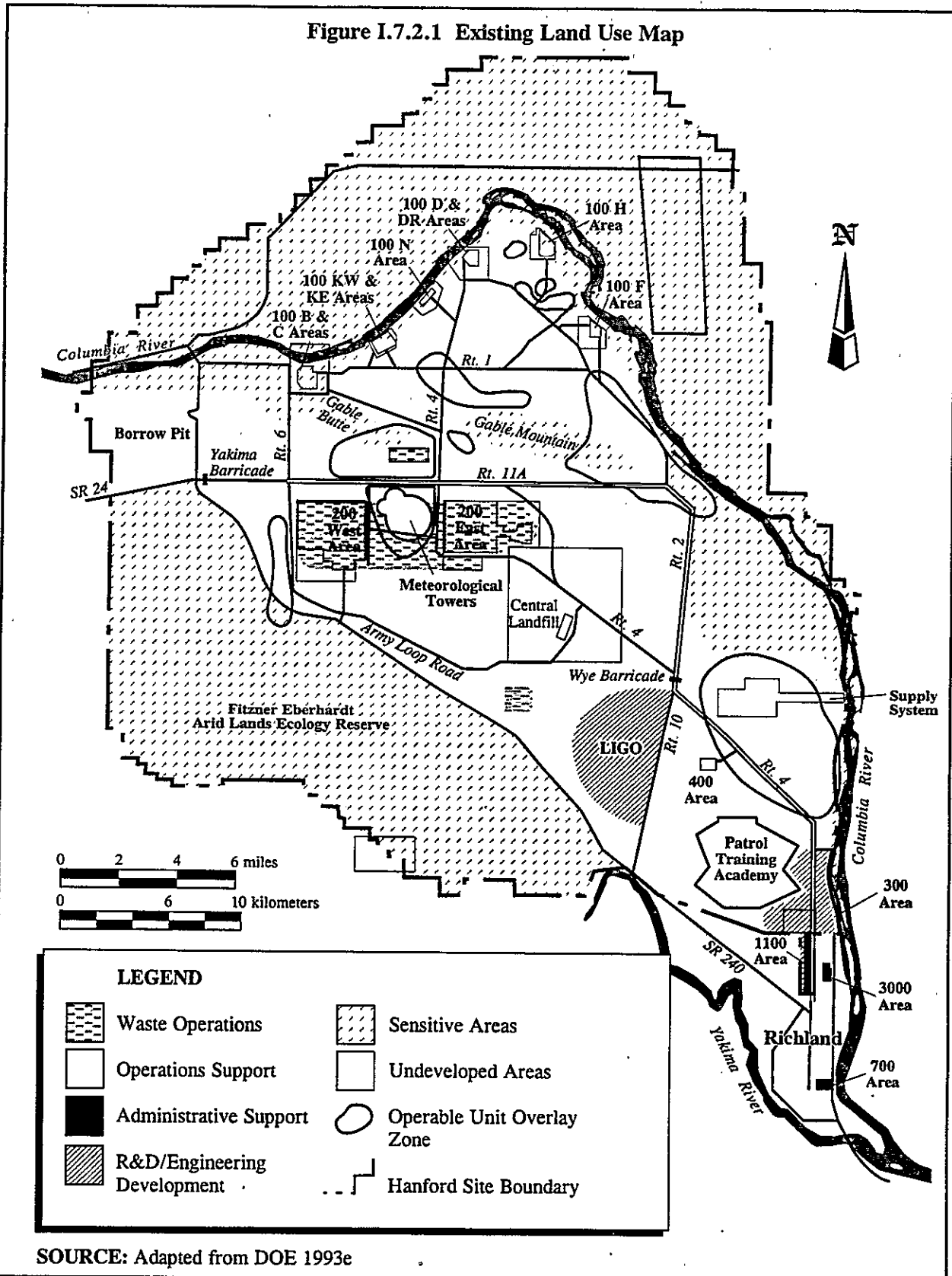
between sensitive natural areas and more intensely developed areas such as the Central Plateau. The HSDP accommodates future intensive uses, such as industrial development and research in the southeast area of the Hanford Site near the urban development of Richland. These more intensive uses are adequately separated from less intensive agricultural uses in Franklin County by the Columbia River. The future land uses are designed to facilitate cleanup, maintain a stable employment and economic foundation, provide energy research and development, continue waste management and disposal activities, and provide environmental protection.

Figure I.7.2.1 identifies the existing land uses on the Hanford Site. The Hanford Site has seven major land-use types:

- Reactor Operations, which involves the development and irradiation of nuclear fuels, fuel fabrication, fuel storage, and reactor plant operations (all operations except storage are currently inactive);
- Waste Operations, which include the treatment, storage, and disposal of radioactive and nonradioactive waste, including waste treatment facility operations, active and inactive tank farms, burial grounds, vaults, and cribs;
- Operations Support, which involves services provided specifically for operations that are primarily industrial;
- Administrative Support, which provides administrative services for overall Hanford Site activities;
- Research and Development and Engineering Development, which includes basic and applied research conducted to advance fundamental scientific knowledge related to Hanford Site activities as well as other major national needs;
- Sensitive Areas, which include environmentally (ecological) or culturally (historical, archaeological, and religious) important areas; and
- Undeveloped Areas, which include areas that have not been developed or have been restored to an undeveloped state. The undeveloped areas also contain sensitive biological and cultural resources.

Sensitive Areas are the largest portion of the existing land use on the Hanford Site. These include the FEALE Reserve, an area that occupies the entire southwest portion of the Hanford Site. Also included are all the Hanford Site lands north of the Columbia River, lands along the river, Gable Butte, Gable Mountain, and an area along the eastern boundary of the Hanford Site south of the river. The area north of the river, the North Slope, is administered by two separate agencies. The U.S. Fish and Wildlife Service (USFWS) administers the area in Grant County west of the northern point of the Hanford Reach known as the Saddle Mountain National Wildlife Refuge. The Washington State Department of Fish and Wildlife Services administers the area in Grant, Adams, and Franklin counties to the north and east of the Hanford Reach, which is known as the Wahluke Wildlife Recreation Area. These areas are undeveloped, natural wildlife areas.

Figure I.7.2.1 Existing Land Use Map



The FEALE Reserve and the North Slope are being considered by DOE for release. The release of the FEALE Reserve could involve land exchange agreements between DOE and the Bureau of Land Management (BLM). The Yakama Indian Nation also has proposed that they take ownership of the Reserve, as have Benton County and Washington State (Stang 1995b). Current considerations for the North Slope involve the proposed National Park Service designation of the area as a National Wildlife Refuge to be administered by the USFWS. Benton, Franklin, and Grant Counties oppose the proposed National Wildlife Refuge designation of the North Slope (Campbell 1995). No final resolution of either of these issues is expected in the immediate future.

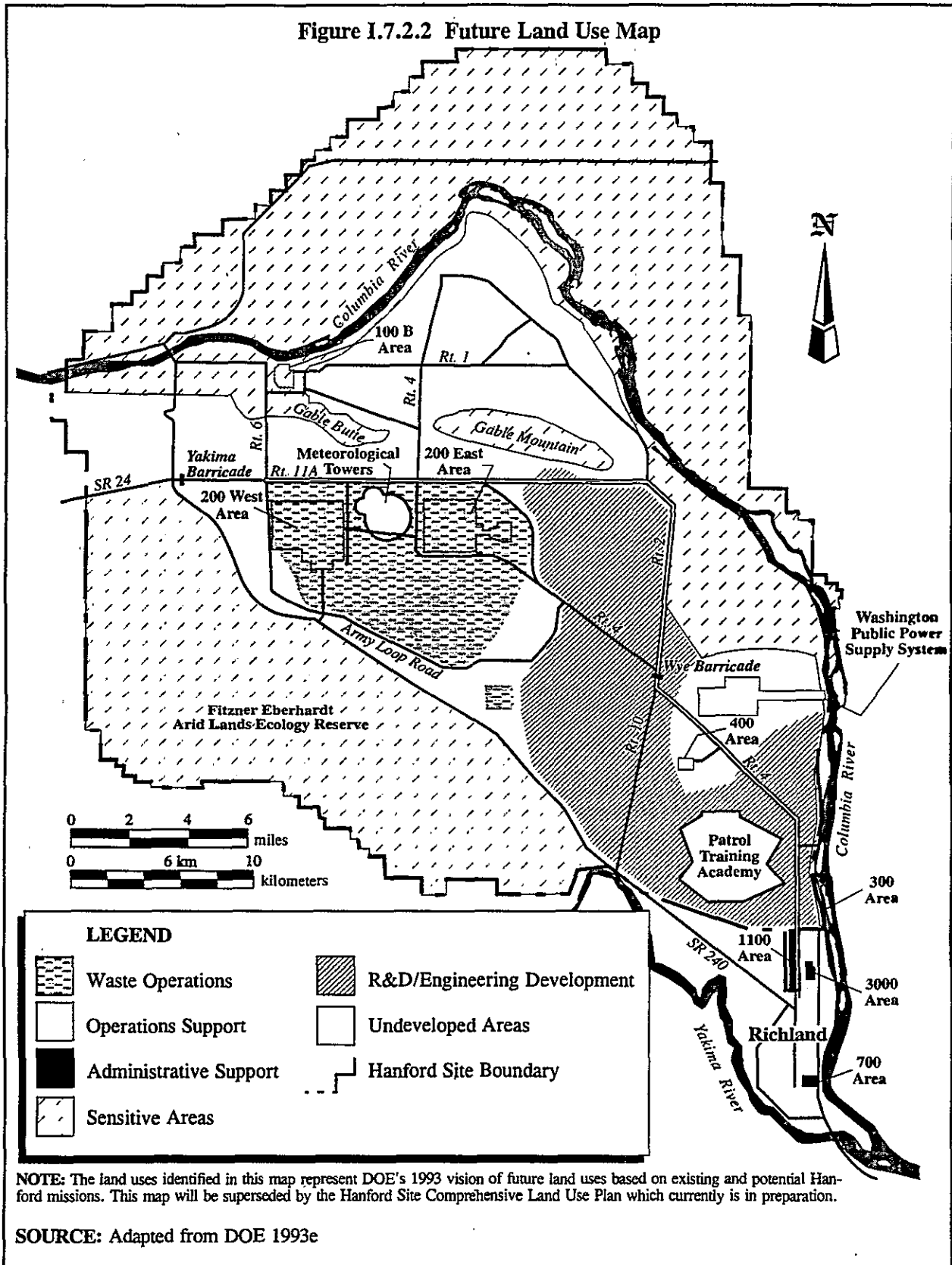
The HSDP contains a Future Land Use Map that presents DOE's 1993 vision of future Site land-use needs (Figure I.7.2.2). The Future Land Use Map was intended for annual updates to reflect mission changes, regulatory decision documents, NEPA documents such as the Hanford Remedial Action EIS and the TWRS EIS, and other appropriate sources (DOE 1993e). However, the Site CLUP, which is due for release in draft form in early 1996 with final decisions expected in early 1997, will provide an official DOE vision of future Site land uses.

As previously mentioned, a goal of the HSDP has been to maximize the amount of land available for other beneficial uses. Future land-use designations were also based on existing and potential Hanford Site missions and assumptions, and the recommendations of the Hanford Future Site Uses Working Group (HFSUWG 1992). The Reactor Operations, Sensitive Areas, and Administrative Support areas remain unchanged from the existing land-use plan (Figure I.7.2.2).

The Hanford Site consists of 1,450 km² (560 mi²) or 145,000 ha (358,000 ac) of land. Of the total Hanford Site area, the Central Plateau, which has been identified for waste management operations, constitutes 117 km² (45 mi²) or 11,700 ha (29,000 ac) of land. This represents approximately 8 percent of the total Hanford Site area. The Central Plateau would consist of 1) a buffer zone of 49 km² (19 mi²) or 4,900 ha (12,000 ac); and 2) a waste management area of 26 km² (10 mi²) or 2,600 ha (6,400 ac). The buffer zone would separate the waste management activities from other areas of the Hanford Site. The 200 Areas would be contained entirely within the waste management area. The 200 Areas consists of 26 km² (10 mi²) or 2,600 ha (6,400 ac) of land. This represents approximately 22 percent of the total Central Plateau waste management area and 2 percent of the total Hanford Site.

The Waste Operations area is primarily limited to the 200 Areas. Virtually all proposed TWRS activities except two potential borrow sites would occur in or between the 200 Areas. The 200 Areas have been used to process irradiated nuclear fuel and store the resulting waste. Existing facilities in this area include the PUREX Plant, the Plutonium Finishing Plant, the U Plant, the tank farms, the Central Waste Complex, and the Waste Sampling and Characterization Facility. The PUREX, Plutonium Finishing Plant, and U Plants are being deactivated (DOE 1993e). The 200 Areas are also used for Research and Development (R&D) and Engineering Development; they also contain meteorological towers.

Figure I.7.2.2 Future Land Use Map



The future locations of the Waste Operations area remain the same although the overall Waste Operation area has been expanded. This expansion reflects land dedicated to a potential cleanup scenario where Sitewide waste is collected and placed in a central location dedicated to exclusive use as a waste disposal area. This includes relocating waste sites, contaminants, and associated structures such as the 100 Area facilities.

According to the HSDP, the future Operations Support areas will remain unchanged except for closing and infilling the borrow pit in the western portion of the Hanford Site. The R&D and Engineering Development area has increased substantially to include the majority of the southeastern portion of the Hanford Site. The Undeveloped Areas, which include areas of sensitive ecological and cultural resources, have been reduced in size to reflect the future release and reuse of portions of the Site. DOE is working with a variety of governmental and nongovernmental organizations to ensure protection, preservation, and proper management of Hanford Site ecological and cultural resources.

The National Park Service released a Final EIS in June 1994 that recommended designating the Hanford Reach portion of the Columbia River as a Recreational River under the Wild and Scenic Rivers Act and also proposed designating the North Slope, an upland area north and east of the river, a National Wildlife Refuge (NPS 1994).

This proposal would transfer management to the USFWS of the river and a 0.40 km (0.25 mi) strip of land along both shores of the river along with approximately 41,300 ha (102,000 ac) of adjacent lands. Development restrictions are included for protecting cultural resources, threatened and endangered species, water quality, unique scenic geologic features, and Native American access and use. The Secretary of the U.S. Department of Interior has issued a Record of Decision indicating a preference for this proposal. This recommendation has been sent to Congress with the final EIS for consideration (NPS 1994).

Benton, Franklin, and Grant counties have opposed the proposed U.S. Department of Interior recommendation. The counties proposed a joint county/State/Federal partnership to plan for future use and management of the Hanford Reach. County commissioners would prefer limited development of the area, with much of the riverfront protected for wildlife and recreation use (Campbell 1995a).

BLM owned many scattered tracts of land on the Hanford Site prior to transferring those lands to the Atomic Energy Commission for national security reasons in 1943. BLM currently does not own any lands on the Site's Central Plateau. However, BLM owns land that includes the potential Vernita Quarry borrow site.

1.7.2.2 Washington State

Washington State has several land interests onsite. The Washington State Department of Natural Resources currently administers the area of the Hanford Site north and east of the Hanford Reach known as the Wahluke State Wildlife Recreation Area. This area is considered sensitive ecological upland habitat and is part of the Wahluke Slope. Washington State also leases a square parcel in the

south-central portion of the Hanford Site between State Route 240 and the Route 2/Route 4 junction. This property is located within the undeveloped area of the Hanford Site.

I.7.2.3 Tribal Nations

The Hanford Site is located on land ceded from the Confederated Tribes and Bands of the Yakama Indian Nation and the Confederated Tribes of the Umatilla Indian Reservation (the Umatilla, Cayuse, and Walla Walla Tribes), based on treaties signed in 1855 (DOE 1992b). The Nez Perce Tribe has treaty rights on the Columbia River under a separate treaty. These treaties reserved specific rights and privileges to the Tribal Nations, as discussed earlier in Section I.5.5.3. The Tribal Nations have often expressed their desire to exercise the rights and privileges to the Hanford Site that were reserved in the 1855 treaties.

I.7.2.4 Local Governments

The Hanford Site is located within portions of Benton, Franklin, Grant, and Adams counties. Other surrounding local jurisdictions include the cities of Richland, West Richland, Pasco, and Kennewick.

Because many of the local jurisdictions' existing comprehensive plans are incomplete or outdated, they have been updated recently or are in the process of being updated as mandated by the 1990 Washington State Growth Management Act. Because of its limited recent growth, Adams County is not updating its plan.

The majority of the Hanford Site is located within Benton County and comprises up to 25 percent of the county land. The cities of Richland, West Richland, Kennewick, Prosser, and Benton City are located in Benton County. The unincorporated areas of the county adjacent to the Hanford Site currently have generalized land-use designations for rangeland and undeveloped and dry agriculture. Rangeland activities consist largely of cattle grazing. Undeveloped or vacant land is primarily open space. Dry agriculture, the largest single land use in the county, consists almost exclusively of dryland wheat and summer fallow (BCBCC 1985).

Benton County officials are concerned with the remediation and potential reuse of the Hanford Site because most of the land-use effects resulting from reuse would occur within Benton County. Benton County is in the process of updating its comprehensive plan. The County plan update will include a separate Hanford Comprehensive Plan that will be consistent with the overall County Plan (Walker 1995). The county's planning process for the Site began in early 1995 and is ongoing. The county is defining critical areas of the Site (e.g., wetlands, areas prone to landslides, fish and wildlife areas) where development would be banned, limited, or allowed only with mitigation measures. The county expects to release a recommended plan with some alternative scenarios in mid-1996. Final decisions would be expected in late 1996 or early 1997 (Stang 1995a).

Franklin County is located east of the Hanford Site and includes the city of Pasco. The unincorporated area of the county adjacent to the Hanford Site is rural and sparsely developed (Franklin County 1982). The land-use designation surrounding the Hanford Site, as with most of the county, is agricultural.

Franklin County adopted an updated comprehensive plan in April 1995. The updated plan does not directly impact any land uses at the Hanford Site (German 1995).

Grant County is located north of the Hanford Reach and includes the Area of the Hanford Site north of the river. The land uses adjacent to the Hanford Site are designated as agricultural (Grant County 1994). This use type is restricted to crop agriculture, agricultural related industries, livestock, and public utility functions (Grant County 1988). Grant County is in the process of updating its comprehensive plan, but the expected date for completion is currently uncertain. However, no changes are expected that would impact the Hanford Site, because the southern portions of the county would remain in agricultural and recreational use (Lambro 1995).

Adams County is located northeast of the Hanford Site although a small portion of the Site is located within Adams County. The land use adjacent to the Hanford Site within Adams County is designated as agricultural (Caputo 1994). These lands are either being used for rangeland or are lying fallow.

The city of Richland is located immediately adjacent to the Hanford Site. Richland is currently in the process of annexing the Site's 1100 Area (Milspa 1995). The existing land uses within Richland near the Hanford Site include industrial, agricultural, and public lands. The planned land use designation within the Richland area adjacent to the Site is identified as industrial (City of Richland 1988). Industrial use is compatible with the adjacent Site use. The city is currently developing a set of alternatives for its updated comprehensive plan, which is expected to be released for public review at the end of 1995. The comprehensive plan itself is expected to be released in mid-1996 (Milspa 1995). With respect to the Hanford Site, the Richland plan focuses only on the southern portions of the Site, which are within the city's 20-year growth boundaries (Stang 1995a). The updated plan would be expected to take advantage of the current and planned Hanford Site research and development and high technology waste management efforts.

West Richland is located to the south of the Hanford Site and is one of the closest developing residential communities. The West Richland land use near the Hanford Site is designated low-density residential (West Richland 1994). This use is consistent with the nearby existing uses (FEALE Reserve and Undeveloped Area) at the Hanford Site. The West Richland Comprehensive Plan update is expected to be released in late 1995 or early 1996. There is little in the update that would impact Hanford Site land-use issues (Corcoran 1995).

Pasco is located southeast of the Hanford Site and includes the Tri-Cities Airport, which is the area's primary airport. Pasco has been planning major commercial, industrial, office, and residential improvements along the Interstate 182 corridor to attract future Hanford Site-related and other businesses (McDonald 1994). Pasco adopted its updated comprehensive plan in August 1995. However, very little in the update is related to Hanford Site land-use issues (McDonald 1995).

Kennewick is located south of the Hanford Site and is separated from the Site by the Yakima River and the city of Richland. Like Pasco, Kennewick has been planning additional industrial and office areas to

attract new businesses. Kennewick adopted its updated comprehensive plan in April 1995. Very little in the updated plan is related to Hanford Site land uses (White 1995).

Another local agency that could be impacted by remediation and reuse of the Hanford Site is the Port of Mattawa. The Port of Mattawa is located in Grant County, northwest of the Hanford Site. The Port of Mattawa is a local government agency obligated to enhance the economic development within District No. 3 of Grant County (Connelly 1994). The Port of Mattawa supports the Wahluke 2000 Plan, proposes, with U.S. Bureau of Reclamation assistance, to expand irrigated farming acreage and increase recreation uses while protecting wildlife habitat (Wahluke 1994). The Wahluke 2000 Plan represents a different approach than the one outlined by the Park Service (in the Hanford Reach EIS), which has proposed a Recreational River status under the Wild and Scenic Rivers Act for the Hanford Reach of the Columbia River.

I.7.3 RECREATIONAL RESOURCES AND THE NATIONAL ENVIRONMENTAL RESEARCH PARK

For the purposes of wildlife management and outdoor recreation, some portions of the Hanford Site are administered by agencies other than DOE. The entire Hanford Site was designated by DOE as a National Environmental Research Park in 1976 (NPS 1994). National Environmental Research Parks are aimed at original research into the ecology and natural sciences of an area. Nearly one-half of the Site is designated for use as wildlife management (Figure I.7.3.1). These wildlife management areas buffer developed areas of the Site. They are the FEALE Reserve, Saddle Mountain National Wildlife Refuge (NWR), Wahluke Wildlife Recreation Area, Rattlesnake Slope Wildlife Area, and McNary NWR. Ecological data have been collected on these sites for more than 40 years.

I.7.3.1 Fitzner Eberhardt Arid Lands Ecology Reserve

The FEALE Reserve is located in the southwest corner of the Hanford Site. Currently, all research activities on the FEALE Reserve are funded by DOE. Consisting of 310 km² (120 mi²) including Rattlesnake Mountain, the FEALE Reserve is managed for DOE by the Pacific Northwest National Laboratory.

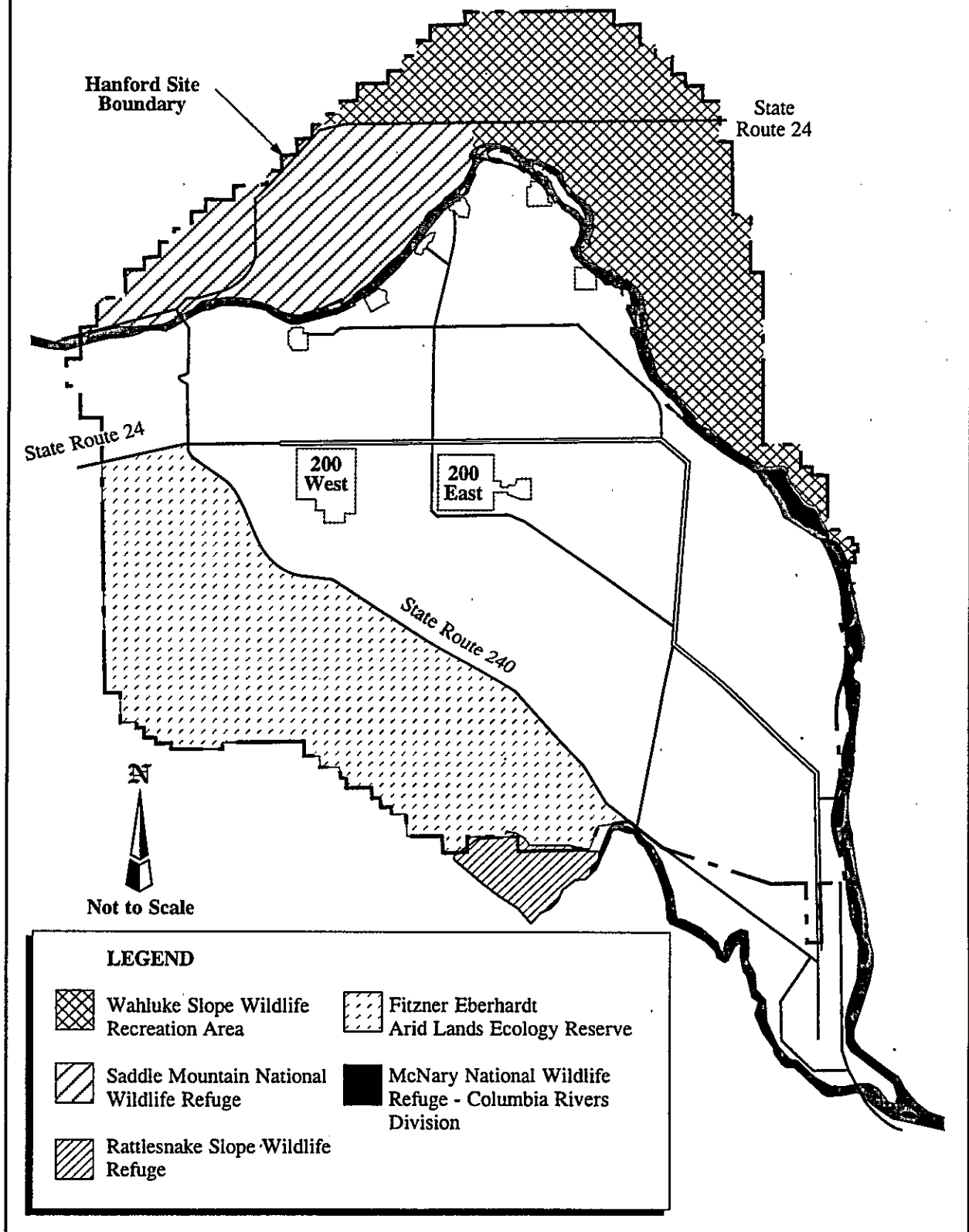
BLM is also involved in the FEALE Reserve. In July 1993, BLM proposed exchanging sections of the Hanford Site with DOE for the FEALE Reserve. BLM proposes to continue management of the FEALE Reserve for its wildlife benefits and to designate it a National Conservation Area.

The Yakama Indian Nation also has proposed assuming control of the Reserve, with an emphasis on wildlife management, as well as use for Native American cultural purposes. In addition, Benton County and Washington State have proposed taking over the FEALE Reserve. No decisions have yet been made with respect to future ownership.

I.7.3.2 McNary National Wildlife Refuge

The McNary NWR, located near the confluence of the Columbia and Snake Rivers, includes three divisions: Burbank Slough, Strawberry Island, and Hanford Islands (Figure I.7.3.1). Only the

Figure I.7.3.1 Recreation and Wildlife Areas and the Hanford Reach



Hanford Islands Division is within the boundaries of the Hanford Site. The Hanford Islands Division contains six islands in the Columbia River and is located upstream from the city of Richland.

The Hanford Islands extend a distance of 14.5 river km (9 river mi) and contain 140 ha (350 ac). The islands are closed to the public during waterfowl nesting season to protect breeding waterfowl, particularly aleutian Canada geese, a Federal and State endangered species.

The NWR was established in 1955 by a cooperative agreement with the U.S. Army Corp of Engineers, which transferred administrative control of nearly 1,200 ha (3,000 ac) of land to the USFWS. Additional acquisitions have enlarged the refuge to the present area of 1,300 ha (3,300 ac). Recreation activities include fishing, picnicking, swimming, and water skiing.

I.7.3.3 Saddle Mountain National Wildlife Refuge

The USFWS manages Saddle Mountain NWR, located on the Hanford Site north and west of the Columbia River (Figure I.7.3.1). Currently, the area is closed to all public use and is dedicated to wildlife management. The USFWS monitors the area for waterfowl populations, kestrel nesting activity, and raptor activity.

The Saddle Mountain NWR was established in 1971 by DOE through a joint agreement with the USFWS. The NWR is located north of the Columbia River from the center of the Hanford Reach to the western boundary of the Hanford Site. The area is currently controlled by DOE but will be transferred to the USFWS upon cleanup of its contaminated sites.

I.7.3.4 Wahluke Wildlife Recreation Area

The Washington State Department of Fish and Wildlife manages the Wahluke Wildlife Recreation Area, located on the Hanford Site north and east of the Columbia River (Figure I.7.2.1). The Wahluke Wildlife Recreation Area is open for public recreation. More than 41,000 people used the area and nearby facilities between July 1988 and July 1989, the most recent year for which statistics are available. More than half of this use took place at the Vernita boat launch, an unimproved launch area immediately upstream of the Vernita Bridge. The Washington State Department of Fish and Wildlife leases approximately 34 ha (85 ac) of Wahluke Wildlife Recreation Area to various private operations for agricultural sharecropping.

I.7.3.5 The Hanford Reach (Proposed Wild and Scenic River Designation)

As the last free-flowing segment of the Columbia River, the Hanford Reach has been proposed for Wild and Scenic River status. The Hanford Reach extends from river mile 396 downstream to river mile 345 and includes those portions of the Columbia River within the boundaries of the Hanford Site. The Hanford Reach boundaries include a 0.4 km (0.25 mi) strip of land on each side of the river, the Saddle Mountain NWR, and the Wahluke Wildlife Recreation Area (Figure I.7.3.1). Designation as a Recreational River (the least restrictive designation under the Wild and Scenic Rivers Act) would provide permanent protection for salmon and cultural resources, enhance wildlife habitats and populations, and improve access and natural resource interpretation for visitors. The USFWS would be

designated as the administrating agency. All lands within the proposed boundary would be transferred to USFWS (NPS 1994).

Benton, Franklin, and Grant counties oppose designating the Hanford Reach as a Wild and Scenic River, contending that it would be too restrictive a designation in terms of allowable land uses. They prefer an approach that would allow for limited development, as well as wildlife protection and recreation (Campbell 1995). No final decisions have yet been made.

1.7.3.5.1 Recreational Use

The Hanford Reach and adjacent wildlife refuge and recreation areas provide a variety of recreational activities year-round for local residents and visitors. The most popular activities are sport fishing, boating, and waterfowl hunting, which are considered substantial in terms of impact on the local economy. Other popular activities include waterskiing, upland hunting, and nature observation. The heaviest use period occurs during September and October, coincident with runs of fall chinook salmon. Hunting occurs in areas downstream of the Hanford Townsite from mid-October until late January each year. Nature observation is most popular during autumn and winter months when the greatest number and diversity of migratory and wintering waterfowl species are present.

Because of restricted use of the Hanford Site and Saddle Mountain NWR lands, virtually all land-based recreation occurs on the Wahluke Wildlife Recreation Area. Water-based recreation is supplemented with boating that originates from areas downstream of the Hanford Site. However, the distance from Richland boat launches to key fishing and sightseeing locations suggests that boating accounts for less than 20 percent of water-based use within the Hanford Reach. Total current recreational use of the Hanford Reach comprises approximately 10,000 land-based visits by hunters, trappers, and nonconsumptive users and approximately 40,000 visits by water-based users (predominantly anglers) per year (NPS 1994).

1.7.3.5.2 Sport Fishing

The Hanford Reach is enjoyed by sport fisherman throughout the Pacific Northwest. Steelhead, sturgeon, and smallmouth bass are the primary sport fish. Of these species, the fall chinook salmon and steelhead are regionally important recreational resources, and the Hanford Reach is one of the leading sport salmon fishing areas along the Columbia River.

1.7.3.5.3 Waterfowl Hunting

Waterfowl hunting is the primary hunting activity in the Hanford Reach. The abundance of waterfowl and availability of favorable hunting conditions make the Hanford Reach a regionally important resource.

1.7.3.5.4 Boating

Although much of the boating along the Hanford Reach is related to fishing or waterfowl hunting, scenery, wildlife, and opportunities for solitude make the area increasingly attractive for recreational boaters. An analysis of flat-water boating rivers throughout Washington State, conducted as part of the

Pacific Northwest River Study, identified the Hanford Reach as a regionally important boating resource (NPS 1994).

I.7.3.5.5 Nature Observation

The Hanford Reach and surrounding lands provide some of the best opportunities for viewing wildlife in eastern Washington State. Bald eagles, loons, pelicans, terns, gulls, great blue herons, mule and white-tailed deer, coyotes, and beavers are some of the larger species that may be observed.

Bird-watching opportunities are optimal during winter months when the Hanford Reach is visited by many species of wintering birds and migratory waterfowl (NPS 1994).

I.7.3.5.6 Swimming

Swimming occurs locally from approximately Memorial Day to Labor Day. Visitors either swim from boats or from the shoreline. There are, however, no developed beaches or designated public swimming areas within the boundaries of the Hanford Site.

I.7.3.5.7 Waterskiing

Waterskiing typically occurs south of the Hanford Site in the vicinity of the city of Richland from mid-May to mid-September. Occasionally, water-skiers travel into the Hanford Reach north of Wooded Island in the vicinity of the Hanford Dunes.

I.7.3.5.8 Other Activities

A relatively small number of people pursue recreational activities within or adjacent to the Hanford Reach. Some activities such as off-road vehicle use, collecting artifacts, and camping are illegal and can be detrimental to the landscape and resources. Off-road vehicle use in the vicinity of White Bluffs has caused considerable damage in some areas and collecting artifacts is an ongoing problem throughout the Site. Camping is permitted at the Ringold boat launch, but occurs illegally at times along other parts of the Hanford Reach shoreline and on some of the islands. The sand dunes are sometimes used by shoreline swimmers, although this is a no-access area (NPS 1994).

I.7.3.6 Rattlesnake Slope Wildlife Refuge

The Rattlesnake Slope Wildlife Refuge is located adjoining the FEALE Reserve's southern boundary. The Refuge, which is managed by Washington State, is outside the boundary of the Hanford Site.

I.8.0 VISUAL RESOURCES

Visual resources reflect the importance of a landscape for its natural or man-made aesthetic qualities and for its sensitivity to change. Landscape character and potential viewing areas are primary factors to be considered in describing the Hanford Site's visual resource values.

I.8.1 LANDSCAPE CHARACTER

The landscape setting within the Hanford Site region is characterized by broad basins and plateaus interspersed with ridges, providing wide, open vistas throughout much of the area. Only about

6 percent of the Site has been disturbed. The remainder of the Site is undeveloped, including natural areas and abandoned agricultural lands that remain undisturbed because of restricted public access.

The major landscape feature of the Hanford Site is the Columbia River, which flows through the northern part of the Hanford Site and turns south, forming the eastern Hanford Site boundary. North of the Columbia River, the Saddle Mountains border the Hanford Site. The Yakima River is located along a small portion of the southern boundary and joins the Columbia River in the city of Richland on the southeastern border of the Hanford Site. Yakima Ridge and Umtanum Ridge form the western boundary of the Hanford Site. Two small east-west ridges, Gable Butte and Gable Mountain, rise above the Central Plateau of the Hanford Site. Adjoining lands to the north, east, and west are principally used for range and agriculture.

The primary focus of the proposed TWRS activities under all EIS alternatives would be in the interior of the Site on the large, flat, open, and semi-arid Central Plateau. Two potential borrow sites, Vernita Quarry and McGee Ranch, are located northwest of the Central Plateau. A third potential borrow site, Pit 30, is located on the Central Plateau between the 200 East and 200 West Areas. The dominant visual features of the Central Plateau vicinity include Gable Butte and Gable Mountain to the north, Rattlesnake Mountain to the south, and Umtanum Ridge to the west.

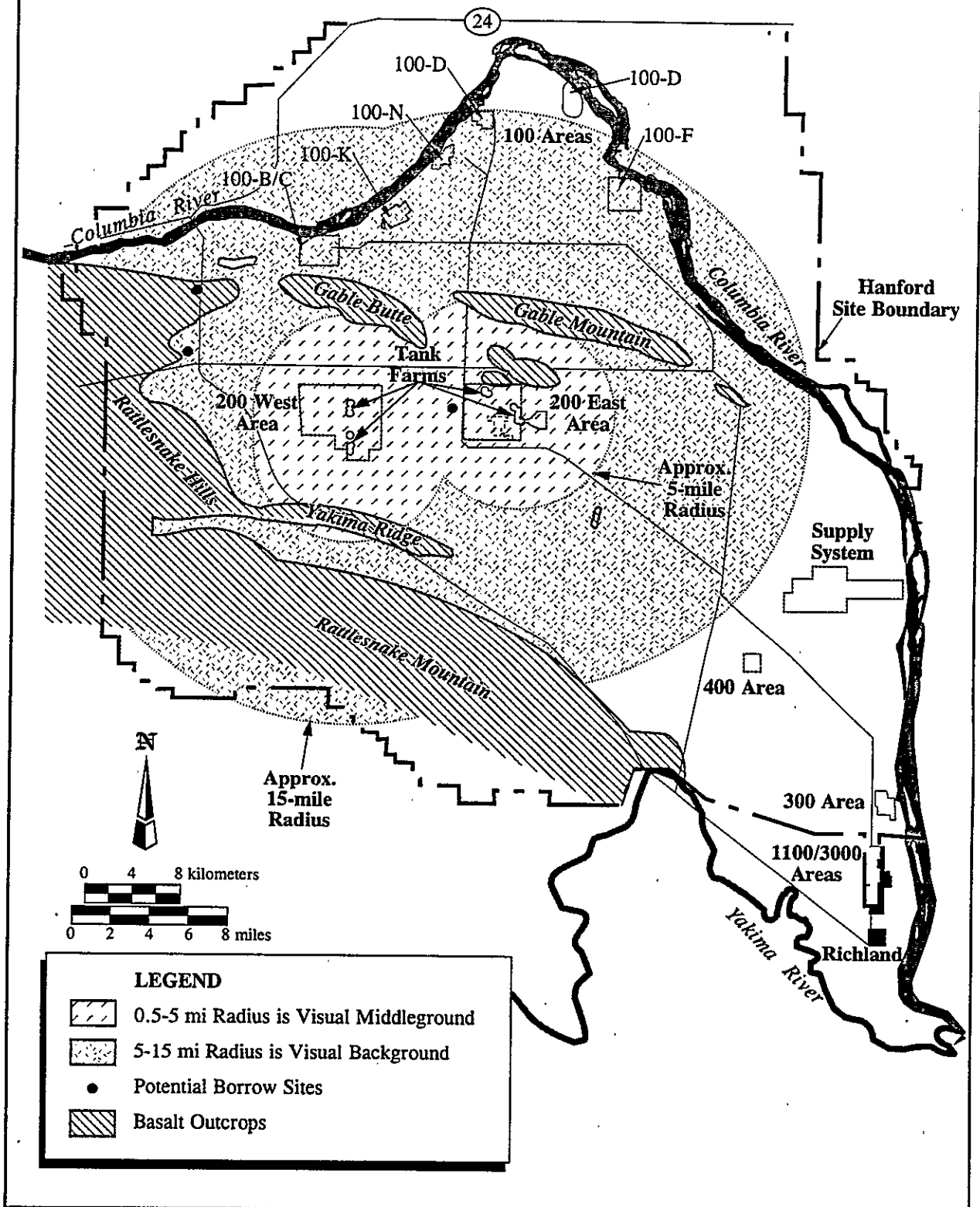
1.8.2 POTENTIAL VIEWING AREAS

For purposes of study and mapping, viewing areas are generally divided into four distance zones; the foreground, within 0.8 km (0.5 mi); the middleground, from 0.8 km (0.5 mi) to 8 km (5 mi); the background, from greater than 8 km (5 mi) to 24 km (15 mi); and seldom seen areas that are either beyond 24 km (15 mi) or are unseen because of topography (Figure 1.8.2.1).

Hanford Site facilities can be seen from elevated locations such as Gable Mountain, Gable Butte, and Rattlesnake Mountain, and from offsite locations including State Routes 240 and 24 and the Columbia River. Because of terrain features, distances involved, the size of the Hanford Site, and the size of the individual facilities, not all facilities are visible from the highways or the Columbia River.

Facilities in the 200 East Area are in the interior of the site and cannot be seen from the Columbia River or State Route 24. Large facilities in the 200 East Area may be visible from State Route 240 only as distant background more than 8 km (5 mi) away. Facilities in the 200 West Area can be seen by travelers on an approximately 11 km (7 mi) segment of State Route 240 south of the Yakima Barricade. For these viewers the facilities are in the visual middleground (0.8 to 8 km [0.5 to 5 mi] away). Facilities in the 200 West Area cannot be seen from the Columbia River. Facilities throughout the 200 Areas are visible from elevated locations such as Gable Mountain, Gable Butte, and Rattlesnake Mountain.

Figure I.8.2.1 Viewing Areas from 200 East and 200 West Areas



The potential Vernita Quarry borrow site is situated on a basalt outcrop immediately adjacent to State Route 24. The basalt resource is exposed in basalt cliffs adjacent to the highway and past quarry operations are highly visible. Quarry activities at the site would be visible from the Vernita Bridge, the Hanford Reach, and the Wahluke Slope north of the Columbia River. The quarry would also be readily observed from State Route 24 leading south from the Vernita Bridge. The potential McGee Ranch borrow site would be located west and north of State Route 24 in slightly rolling terrain.

The borrow site would be readily visible from South Route 24 south and east of the borrow site. The potential Pit 30 borrow site is located between the 200 East and 200 West Areas and is only visible offsite from elevated locations.

I.9.0 NOISE

Noise as defined by Washington State constitutes the intensity, duration, and character of sounds from any and all sources (WAC 173-60). Sound is produced when a noise source induces vibrations into the surrounding air causing fluctuations in atmospheric pressure. Decibels (dB) are units of sound pressure used to measure changes in atmospheric pressure caused by the vibrations. Primary factors that influence the measurement of noise in ambient air are frequency and duration. The normal human auditory system cannot clearly discern sounds below 100 Hz (hertz or Hz is a measure of frequency or pitch) or substantially above 10,000 Hz. Sound occurring outside this range is not generally perceived as noise. Researchers have developed an A-weighted noise scale (dBA) to describe sounds emanating in those frequencies that are most readily detected by normal human hearing. Table I.9.0.1 lists some common levels of sound and their corresponding dBA levels. Sound duration is another important factor in determining cumulative noise impacts. Noise levels often are reported as the equivalent sound level (L_{eq}) and expressed as a weighted average (dBA) over a specified period of time; the L_{eq} integrates noise levels over time and expresses them as steady-state continuous sound levels.

I.9.1 REGULATORY CONTEXT AND PREVIOUS NOISE STUDIES

The Hanford Site (including its unoccupied areas) is classified as a Class C Environmental Designation for Noise Abatement (EDNA) by Washington State on the basis of industrial activities (Table I.9.1.1). Because they are neither Class A (residential) nor Class B (commercial), unoccupied Hanford Site areas are also classified as Class C areas.

Because of the remoteness of the Hanford Site, only a limited number of studies have been conducted that document environmental noise levels. Two sources of measured environmental noise at Hanford Site are 1) measurements made in 1981 during Hanford Site characterization of the Skagit/Hanford Nuclear Power Plant Site; and 2) noise measurements at five Hanford Site locations performed in 1987 as part of the Basalt Waste Isolation Project.

Table I.9.0.1 Common Sounds and Corresponding Noise Levels

Common Sounds	Sound Level (dBA)	Loudness
Air Raid Siren	140	Uncomfortable
Subway	100	Very Loud
Gas Lawn Mower at 0.9 m (3 ft)	94	
Food Blender at 0.9 m (3 ft)	88	Loud
Garbage Disposal	80	
Inside an Automobile at 64.4 km/hr (40 mi/hr)	75	Moderate
Normal Speech	60	
Outside an Automobile at 61 m (200 ft)	55	
Private Office	50	Quiet
Library	35	
Quiet Rural Nighttime	25	Very Quiet
Whisper	20	
Threshold of Hearing	5	Barely Audible

Notes:

dBA = decibels on the A scale

km/hr = kilometers per hour

mi/hr = mile per hour

Source: Bell 1973

Table I.9.1.1. Applicable State Noise Limitations for the Hanford Site ¹

Environmental Designation for Noise Abatement		Maximum Allowable Noise Level in L_{eq} (dBA)
Source Area	Receptor Area	
Class C (industrial)	Class A (residential)	60 (day) 50 (night)
	Class B (commercial)	65 (day)
	Class C (industrial)	70 (day)

Notes:

¹ Based on source and receptor environmental designation for noise abatement designation. L_{eq} = equivalent sound level

Source: WAC 173-60-040, DOE 1991

I.9.1.1 Skagit/Hanford Studies

During preconstruction measurements of environmental noise associated with the Skagit/Hanford Nuclear Power Plant Site, 15 sites were monitored and noise levels ranged from 30 to 65 dBA (L_{eq}). The values for isolated areas ranged from 30 to 38.8 dBA (L_{eq}). Measurements taken at the proposed reactor sites ranged from 50.6 to 64 dBA. Measurements taken along the Columbia River near the

proposed intake structures were 47.7 and 52.1 dBA, as compared to noise levels of 45.9 dBA measured at a more remote location about 5 km (3 miles) upstream from the intake structures. By comparison, community noise levels in North Richland (at Horn Rapids Road and the Bypass Highway) were 60.5 dBA (NRC 1982).

I.9.1.2 Basalt Waste Isolation Project Studies

As part of the investigation for proposed Basalt Waste Isolation Project at the Hanford Site, background noise levels were determined at five locations. Noise levels can be expressed as L_{eq} for 24 hours (L_{eq-24}). Based on information provided in Cushing (Cushing 1994), wind was identified as the primary contributor to background noise levels with winds exceeding 19 km/hour (12 mi/hour), substantially impacting noise levels. As a result, it was concluded that background noise levels in undeveloped areas at the Hanford Site can best be described as having a mean L_{eq-24} of 24 to 36 dBA. Periods of high wind, which normally occur in the spring, would elevate background noise levels.

I.9.1.3 Noise Levels of Hanford Field Activities

To protect Hanford Site workers and to comply with Occupational Safety and Health Administration standards for noise in the workplace, the Hanford Environmental Health Foundation monitors noise levels resulting from routine operations performed at the Hanford Site (DOE 1991 and Cushing 1992). Occupational sources of noise propagated in the field are summarized in Table I.9.1.2. These levels are reported because operations such as well sampling are conducted in the field away from established industrial areas and have the potential for contributing to environmental noise and disturbing sensitive wildlife.

Table I.9.1.2 Monitored Levels of Noise Propagated from Outdoor Activities at the Hanford Site¹

Activity	Average Noise Level	Maximum Noise Level	Year Measured
Water Wagon Operation	104.5	111.9	1984
Well Sampling	74.8 to 78.2		1987
Truck	78 to 83		1989
Compressor	88 to 90		
Generator	93 to 95		
Well Drilling, Well 32-2	98 to 102	102	1987
Well Drilling, Well 32-3	105 to 11	120 to 125	1987
Well Drilling, Well 33-29	89 to 91		1987
Pile Driver (diesel 5 ft from source)	118 to 119		
Tank Farm Filter Building (30 ft from source)	86		1976

Notes:

¹ Noise levels measured in decibels (dB).

Source: Cushing 1992, DOE 1991

I.9.2 HANFORD SITE NOISE CONDITIONS

Existing noise conditions produced by current, routine operations at the Hanford Site do not violate any Federal or State standards. Measurements show that even near the current operating structures along the Columbia River noise levels are less than experienced in part of the community of Richland (less than 52.1 dBA versus 60.5 dBA). Noise levels measured near intake structures at the Columbia River

are well within the 60 dBA tolerance levels for daytime residential use. Five km (3 mi) upstream of the intake structures noise levels fell well within levels suited for daytime and nighttime residential use.

Moreover, the remoteness of the main areas of Hanford Site industrial activities from population centers means that there are no offsite populations within auditory range of Site industrial activities.

I.10.0 TRANSPORTATION

The Tri-Cities area is served by air, rail, water, and road transportation networks. The majority of air passenger and freight services goes through the Tri-Cities Airport, located in Pasco (Cushing 1992). In addition, two smaller airports serving general aviation aircraft are located in Richland and Kennewick, respectively. No airport facilities are located on the Hanford Site.

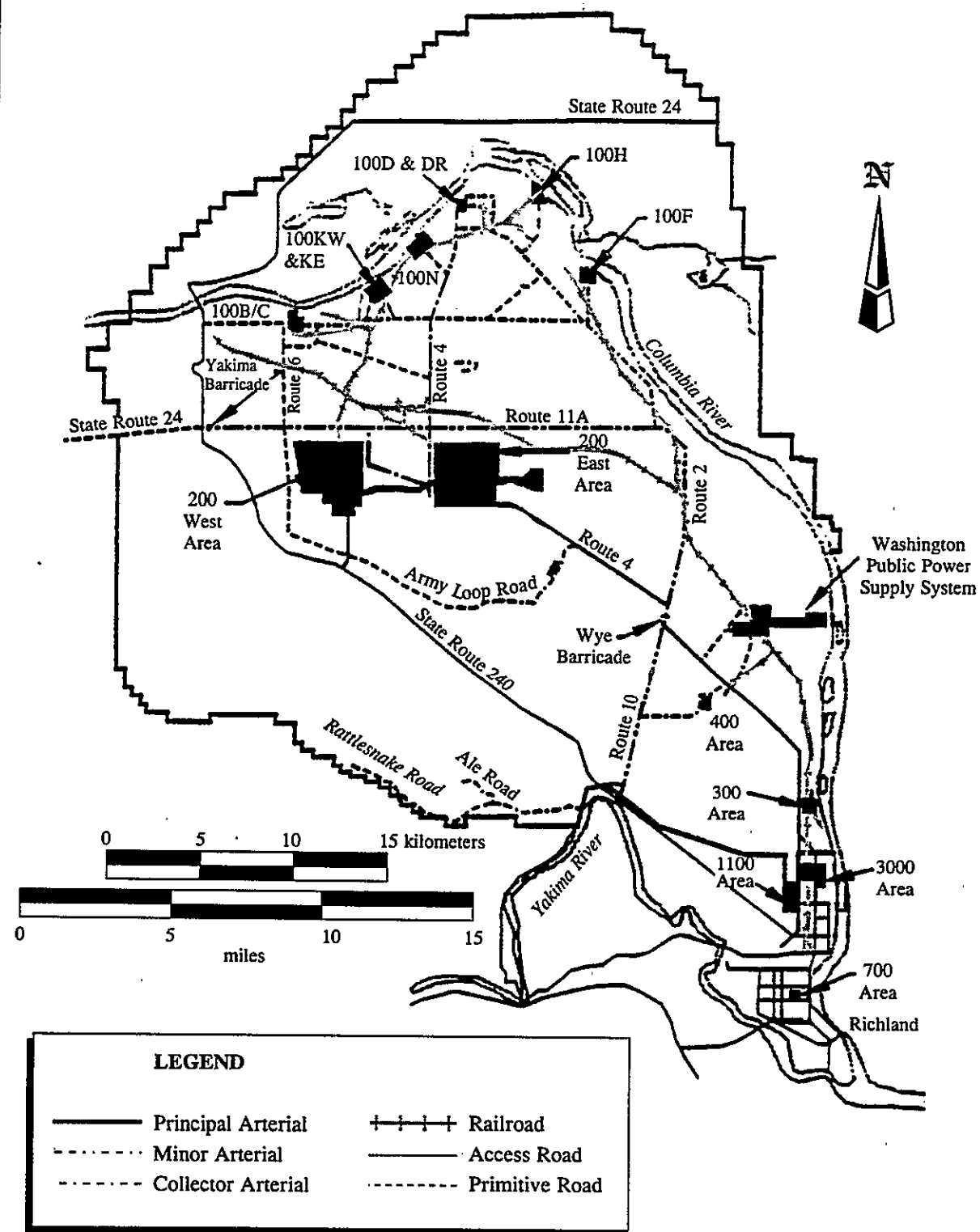
Water-borne transportation is accommodated by docking facilities at the Ports of Benton, Kennewick, and Pasco (Cushing 1992). The commercial waterways of the Snake and Columbia Rivers provide access to the deep-water ports of Portland, Oregon and Vancouver, Washington. The Port of Benton is the port-of-call for all vessel traffic to the Hanford Site.

The Hanford Site rail system consists of about 210 km (130 mi) of railroad track. Approximately 140 km (87 mi) of the system are considered in service to active Site facilities. Approximately 64 km (40 mi) of track are in standby condition. The standby trackage serves Site areas that have no current rail shipping needs. Although the standby track is not currently maintained, it could be restored if needed. The Hanford Site rail system extends from the Richland Junction (at Columbia Center in Kennewick) south of the Columbia River where it joins the Union Pacific commercial railroad track, to an abandoned commercial right-of-way near the Vernita Bridge in the northern portion of the Site (Figure I.10.0.1). There are currently about 1,400 rail car movements annually Sitewide, transporting a wide variety of materials including fuels (e.g., coal and oil), hazardous process chemicals, and radioactive materials and equipment. Radioactive waste has been transported by rail on the Site without incident for many years (DOE 1995i).

Regional road transportation is provided by a number of major highways including State Routes 240 and 24 and U.S. Interstate Highway 82. State Routes 240 and 24 are both two-lane roads that traverse the Hanford Site. State Route 240 is a north-south highway that skirts the easternmost side of the FEAL Reserve. State Route 24 is an east-west highway located in the northern portion of the Hanford Site. These roads are maintained by Washington State (Cushing 1992).

A DOE-maintained road network within the Hanford Site provides access to the various work centers (Figure I.10.0.1). The majority of these roads are paved and are two-lanes wide. The primary access roads on the Hanford Site are Routes 2, 4, 10, and 11A. The 200 East Area is primarily accessed by Route 4 South from the east and from Route 4 North off Route 11A from the north and from Route 11A for vehicles entering the Site at the Yakima Barricade. A new access road was opened in late 1994 to provide access directly to the 200 Areas from State Route 240. The 200 West Area is primarily accessed from Route 6 off Route 11A from the north. Public access to the 200 Areas and

Figure I.10.0.1 Hanford Site Transportation Network



SOURCE: Adapted from DOE 1994a

interior locations of the Hanford Site has been restricted by guarded gates at the Wye Barricade (at the intersection of Routes 10 and 4) and the Yakima Barricade (at the intersection of State Route 240 and Route 11A). None of the previously listed roadways have experienced any substantial congestion except Route 4 (WHC 1994c).

Route 4 carries most of the traffic from the city of Richland to the 200 Areas. Traffic volumes during shift changes at the Hanford Site create severe traffic congestion. July 1994 traffic counts along Route 4 South just to the west of the Wye Barricade showed an average daily traffic (ADT) of approximately 9,200 vehicles, with morning peak hour volumes of nearly 2,400. By mid-1995 with reductions in Site employment, and the opening of the State Route 240 Access Road (Beloit Avenue), morning peak hour traffic had declined to slightly above 1,700 (Rogers 1995). Farther to the southeast, near the 1100 Area where Route 4 becomes Stevens Road, the 1992 ADT was approximately 24,800 with a peak hour volume of over 2,900. Level of Service (LOS) is a qualitative measure of a roadway's ability to accommodate vehicular traffic, ranging from free flow conditions (LOS A) to extreme congestion (LOS F). LOS D is considered the upper end of acceptable LOS. A 1994 report indicated that Route 4 was operating at LOS E and a 1993 report indicated that Stevens Road was operating at LOS F (WHC 1994c and BFRC 1993). The factors indicated previously, namely, Site employment reductions, and the heavy use of the new State Route 240 Access Road (peak hour volume of nearly 900 vehicles by mid-1995), have reduced the traffic congestion in these areas (Rogers 1995).

Traffic counts along Route 11A, which is just to the east of the Yakima Barricade off of State Route 240, show an ADT of approximately 1,260. Traffic counts along Route 10, just to the north of its terminus at State Route 240, show an ADT of approximately 2,440 (WHC 1994c).

I.11.0 RADIOLOGICAL ENVIRONMENT: OVERVIEW AND POTENTIAL RADIATION DOSES FROM 1994 HANFORD SITE OPERATIONS

This section provides a brief introduction to the subject of radioactivity and to some of the common terms used in radiological health evaluation. It also summarizes 1994 data on radiation doses from operations at the Hanford Site and estimates the potential future fatal cancers attributable to these radiation exposures.

I.11.1 INTRODUCTION TO RADIOACTIVITY

Radioactivity is a broad term that refers to changes in the nuclei of atoms that release radiation. Radiation is an energetic ray or energetic particle. For ionizing radiation, the ray or particle has enough energy to cause changes in the chemical structure of the materials it strikes. These chemical structure changes are the mechanisms by which radiation can cause biological damage to humans.

Radiation comes from many sources, some natural and some manmade. People have always been exposed to natural or background radiation. Natural sources of radiation include the sun, and radioactive materials present in the earth's crust, in building materials and in the air, food, and water. Natural radioactivity can even be found within the human body. Some sources of ionizing radiation have been created by people for various uses or as by products of these activities. These sources

include nuclear power generation, medical diagnosis and treatment, and nuclear materials related to nuclear weapons.

Radioactive waste is a result of the use and production of radioactive materials. At the Hanford Site, DOE manages radioactive waste that was generated primarily by the production of plutonium for nuclear weapons. This waste is classified as low-activity, high-level, or transuranic. When radioactive waste is combined with hazardous chemical wastes, it is referred to as mixed waste. High-level waste is the most dangerous type of radioactive waste and requires extensive shielding by materials such as lead and concrete and special handling. Transuranic waste is material contaminated with radioactive elements heavier than uranium. While long lasting, transuranic waste does not require the degree of isolation as high-level waste. Low-activity waste is generally the least dangerous type of radioactive waste and requires fewer measures to isolate it from people and the environment. Depending on the particular radioactive material involved, radioactive waste can be harmful and thus require isolation for up to hundreds or even thousands of years. Plutonium-contaminated waste will be radioactive for thousands of years. Radioactive cesium, on the other hand, will be virtually gone in 250 years.

I.11.2 COMMON TERMS IN RADIOLOGICAL HEALTH EVALUATIONS

Radiation dose to individuals is usually expressed in rem or millirem (mrem), which is one-thousandth of a rem. The rem is a measure of the biological effects of ionizing radiation on people. It is estimated that the average individual in the United States receives an annual dose of about 300 millirems from all natural sources. The collective radiation dose to a population is termed the person-rem, which is calculated by adding up the radioactive dose to each member of the population.

Any dose of radiation can damage body cells. However, at low levels, such as are received from a medical x-ray, the damage to cells is so slight that the cells can usually repair themselves or can be replaced by the regeneration of healthy cells. Radiation exposures are often classified as acute (a dose received over a short time) or chronic (a dose received over a long time). Chronic doses are usually less harmful than acute doses because the body has time to repair or replace damaged cells.

Impacts from radiation exposure often is expressed using the concept of risk. The most substantial radiation-related risk is the potential for developing cancers that may cause death in later years. This delayed effect is measured in latent (future) cancer fatalities. The risk of a latent cancer fatality is estimated by converting radiation doses into possible numbers of cancer fatalities. For an entire exposed population group, the latent cancer fatality numerical value is the chance that someone in that group would develop an additional cancer fatality in the future because of the radiation exposure, (i.e., a cancer fatality that otherwise would not occur).

Radiological risk evaluations often refer to the maximally-exposed individual. This would be the member of the public or a worker who receives the highest possible dose in a given situation. As a practical matter, the maximally-exposed individual likely would be a person working with radiological or hazardous materials.

I.11.3 POTENTIAL RADIATION DOSES AND LATENT CANCER FATALITIES FROM 1994 HANFORD SITE OPERATIONS

Each year potential radiation doses to the public are calculated for exposure to Hanford Site effluents. The 1994 information presented here was taken from the Hanford Site Environmental Report for Calendar Year 1994 (PNL 1995). Doses are calculated from reported effluent releases, from environmental surveillance results, and from information about operations at specific Hanford Site facilities.

The 1994 potential dose from Hanford Site operations to the hypothetical maximally-exposed individual member of the public was 0.05 mrem. The current DOE radiation dose limit for an individual member of the public is 100 mrem per year, and as stated previously, the national average dose from natural sources is 300 mrem per year. Thus, the maximally exposed individual potentially received 0.05 percent of the DOE dose limit and 0.02 percent of the natural background average dose.

The total population of the surrounding area (380,000 persons) received a potential dose from 1994 Hanford Site operations of 0.6 person-rem. The 1994 average dose to an individual member of the public was 0.002 mrem. This is 0.002 percent of the 100 mrem/year standard and 0.0007 percent of the 300 mrem per year received from typical natural sources. Clean Air Act requirements specify a maximum radiation dose through the air of 10 mrem per year. The 1994 air emissions from the Hanford Site were 0.01 mrem, which is 0.1 percent of the 10 mrem standard.

Based on a dose-to-risk conversion of $5E-04$ latent cancer fatalities per rem (each rem equates to 0.0005 latent cancer fatalities), there would be 0.0003 latent cancer fatalities in the general public attributable to exposure to effluents from 1994 Hanford Site operations.

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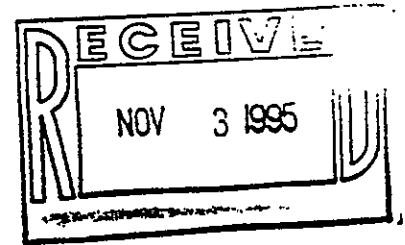
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APPENDIX J
CONSULTATION LETTERS

APPENDIX J CONSULTATION LETTERS

The National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA) implementing regulations require that Federal agencies consult with Federal, State, and local agencies and Tribes (as appropriate) regarding proposed actions addressed in Environmental Impact Statements (EIS). The U.S. Department of Energy (DOE) and the Washington State Department of Ecology (Ecology) have performed this consultation through informal meetings, discussions, and correspondence. DOE and Ecology have provided formal requests for information and consultations to Federal, State, and local agencies and Tribes that may have regulatory jurisdiction or special interest in the issues and alternatives to be addressed in the TWRS EIS. This appendix contains copies of the consultation letters sent by DOE and Ecology to agencies and Tribes and the responses by those agencies and Tribes.



STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

October 30, 1995

Mr. Robert Turner
Director
Washington State Department of Fish and Wildlife
600 Capital Way North
Olympia, WA 98501-1091

Dear Mr. Turner:

**Re: DOE HANFORD TANK WASTE REMEDIATION SYSTEM
ENVIRONMENTAL IMPACT STATEMENT (TWRS EIS)**

The U.S. Department of Energy (USDOE) and the Washington State Department of Ecology (Ecology) are jointly preparing the Tank Waste Remediation System (TWRS) Environmental Impact Statement (EIS). The TWRS EIS will address USDOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the USDOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed action and alternatives on a wide variety of environmental, human health risk, and socioeconomic issues. As part of the intergovernmental consultation required in USDOE's National Environmental Policy Act process and in accordance with the State Environmental Policy Act, USDOE and Ecology invite the Department of Fish and Wildlife (WDF&W) to identify specific issues and concerns your Department believes should be addressed in the TWRS EIS. To facilitate incorporation of WDF&W input into the Draft EIS, please provide any response in writing within 30 days.

If you have any questions, or to coordinate your response to this letter please contact: Geoff Tallent, TWRS EIS Project Lead, Washington Department of Ecology, P.O. Box 47600, Olympia, WA 98504-7600. Phone number (360) 407-7112.

Thank you for your interest in this matter.

Sincerely,

Mike Wilson, Manager
Nuclear Waste Program

MW:GT:djb

cc: Martin Baker, WDF&W - Olympia
Ted Clausing, WDF&W - Yakima
Jay McConnaughey, WDF&W - Hanford Site
Dave Nichols, Jacobs Engineering
Project File



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NOV 22 1995

State of Washington
DEPARTMENT OF FISH AND WILDLIFE

Mailing Address: 600 Capitol Way N, Olympia WA 98501-1081 • (206) 902-2200; TDD (206) 902-2207
Main Office Location: Natural Resources Building, 1111 Washington Street SE, Olympia, WA

November 17, 1995

Mr. Mike Wilson
Nuclear Waste Program Manager
Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Dear Mr. Wilson:

Thank you for the formal consultation opportunity you have given Washington Department of Fish and Wildlife concerning the DCE Hanford Tank Waste Remediation System Environmental Impact Statement (TWRIS EIS). We have no additional substantive comments at this time. However, we would like to commend Ecology for the close coordination maintained with our technical staff throughout this EIS process. We appreciate the extra efforts Geoff Tallent of your staff has been making to take our concerns into consideration.

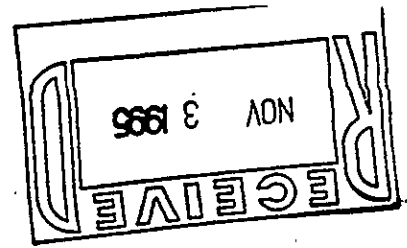
Additional technical questions should continue to be addressed by Jay McConnaughey, biologist for the Hanford Site, who works out of your Kennewick Office. We look forward to reviewing the Draft Environmental Impact Statement when it is released.

Sincerely,

A handwritten signature in cursive script, appearing to read "Martin Baker".

Martin Baker
Assistant Director
Habitat Program

cc: Gordy Zillges
Ted Clausen
Jay McConnaughey



STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600

October 30, 1995 (360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

Mr. Jerry Alb
Washington State Department of Transportation
Environmental Affairs Office
310 Maple Park East, P.O. Box 47331
Olympia, WA 98504-7301

Dear Mr. Alb:

**Re: DOE HANFORD TANK WASTE REMEDIATION SYSTEM
ENVIRONMENTAL IMPACT STATEMENT (TWRS EIS)**

The U.S. Department of Energy (USDOE) and the Washington State Department of Ecology (Ecology) are jointly preparing the Tank Waste Remediation System (TWRS) Environmental Impact Statement (EIS). The TWRS EIS will address USDOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the USDOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed action and alternatives on a wide variety of environmental, human health risk, and socioeconomic issues. As part of the intergovernmental consultation required in USDOE's National Environmental Policy Act process and in accordance with the State Environmental Policy Act, USDOE and Ecology invite the Department of Transportation to identify specific issues and concerns your Department believes should be addressed in the TWRS EIS. To facilitate incorporation of DOT input into the Draft EIS, please provide any response in writing within 30 days.

If you have any questions, or to coordinate your response to this letter please contact: Geoff Tallent, TWRS EIS Project Lead, Washington Department of Ecology, P.O. Box 47600, Olympia, WA 98504-7600. Phone number (360) 407-7112.

Thank you for your interest in this matter.

Sincerely,

Mike Wilson, Manager
Nuclear Waste Program

MW:GT:djb

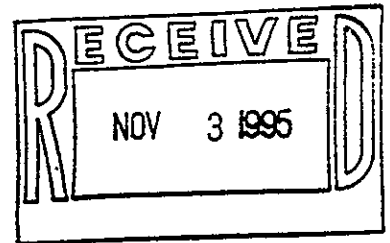
cc: Dave Nichols, Jacobs Engineering
Project File



STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
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October 30, 1995

Mr. Eric Slagle
Assistant Secretary of Environmental Health
Washington State Department of Health
AIRDUSTRIAL Center, Building #2
P.O. Box 47821
Olympia, WA 95804-7821

Dear Mr. Slagle:

**Re: DOE HANFORD TANK WASTE REMEDIATION SYSTEM
ENVIRONMENTAL IMPACT STATEMENT (TWRS EIS)**

The U.S. Department of Energy (USDOE) and the Washington State Department of Ecology (Ecology) are jointly preparing the Tank Waste Remediation System (TWRS) Environmental Impact Statement (EIS). The TWRS EIS will address USDOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the USDOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed action and alternatives on a wide variety of environmental, human health risk, and socioeconomic issues. As part of the intergovernmental consultation required in USDOE's National Environmental Policy Act process and in accordance with the State Environmental Policy Act, USDOE and Ecology invite the Department of Health (DOH) to identify specific issues and concerns your Department believes should be addressed in the TWRS EIS. To facilitate incorporation of DOH input into the Draft EIS, please provide any response in writing within 30 days.

If you have any questions, or to coordinate your response to this letter please contact Geoff Tallent, TWRS EIS Project Lead, Washington Department of Ecology, P.O. Box 47600, Olympia, WA 98504-7600. Phone number is (360) 407-7112.

Thank you for your interest in this matter.

Sincerely,

Mike Wilson, Manager
Nuclear Waste Program

MW:JT:djb

cc: T.R. Strong, DOH
Craig Lawrence, DOH
Dave Nichols, Jacobs Engineering
Project File



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 28 1995

95-PRI-190

Mr. Russell Jim, Manager
Environmental Restoration/
Waste Management Program
Confederated Tribes and Bands
of the Yakama Indian Nation
P.O. Box 151
Toppenish, Washington 98948

Dear Mr. Jim:

**THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)**

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

Consistent with various Federal and State laws, including the National Historic Preservation Act and the Native American Religious Freedom Act, among others, DOE and Ecology will analyze the proposed TWRS action and alternatives in terms of their impacts on cultural resources and traditional cultural properties. The EIS also will address a wide range of environmental, human health risk, and socioeconomic issues.

Based on these Federal laws and as part of DOE's National Environmental Policy Act process and Ecology's State Environmental Policy Act and the DOE American Indian Tribal Governmental Policy, DOE and Ecology requests formal consultation with the Yakama Nation so that the Nation can identify and comment on specific issues and concerns that it feels should be addressed in the TWRS EIS. To facilitate incorporation of the Yakama Nation's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please recognize that this consultation letter is only part of the overall process to which DOE and Ecology is committed to for involving the Yakama Nation the TWRS EIS. The Draft and Final EISs, of course, will be formally provided for your review and comment.

Further, DOE expects to consult with the Tribe throughout the TWRS EIS process. For example, DOE is prepared to have consultation meetings or briefings where you feel that such meetings or briefings will be useful to address specific issues of importance to the Tribe. DOE and Ecology would

NOV 09 1995

Mr. Russell Jim
95-PRI-190

-2-

welcome the opportunity to have such a meeting during the week of December 4-8, 1995, prior to the release of the draft EIS. To arrange a meeting date, time and location I will contact you by November 15, 1995.

As other useful information and consultation activities occur to you, please notify us and DOE will try to accommodate your request. Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,



Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 03 1995

95-PRI-187

Mr. J. R. Wilkinson, Manager
Hanford Program
Confederated Tribes of the
Umatilla Indian Reservation
Pendleton, Oregon 97801

Dear Mr. Wilkinson:

**THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)**

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

Consistent with various Federal laws, including the National Historic Preservation Act and the Native American Religious Freedom Act, among others, DOE will analyze the proposed TWRS action and alternatives in terms of their impacts on cultural resources and traditional cultural properties. The EIS also will address a wide range of environmental, human health risk, and socioeconomic issues.

Based on these Federal laws and as part of DOE's National Environmental Policy Act process and the DOE American Indian Tribal Governmental Policy, DOE requests formal consultation with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) so that the Tribe can identify and comment on specific issues and concerns that it feels should be addressed in the TWRS EIS. To facilitate incorporation of CTUIR's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please recognize that this consultation letter is only part of the overall process to which DOE is committed for involving the CTUIR in the TWRS EIS. The draft and final EISs, of course, will be formally provided for your review and comment.

Further, DOE expects to consult with the Tribe throughout the TWRS EIS process. For example, DOE is prepared to have consultation meetings or briefings where you feel that such meetings or briefings will be useful to address specific issues of importance to the Tribe. DOE and Ecology would welcome the opportunity to have such a meeting during the week of December 4-8, 1995, prior to the release of the draft EIS. To arrange a meeting date, time and location I will contact you by November 15, 1995.

NOV 03 1995

Mr. J. R. Wilkinson
95-PRI-187

-2-

As other useful information and consultation activities occur to you, please notify us and DOE will try to accommodate your request.

Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,



Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 28 1995

95-PRI-179

Ms. Donna Powauke, Manager
Environmental Restoration/
Waste Management Program
The Nez Perce Tribe
P.O. Box 365
Lapwai, Idaho 83540

Dear Ms. Powauke:

**THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)**

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

Consistent with various Federal laws, including the National Historic Preservation Act and the Native American Religious Freedom Act, among others, DOE will analyze the proposed TWRS action and alternatives in terms of their impacts on cultural resources and traditional cultural properties. The EIS will also address a wide range of environmental, human health risk, and socioeconomic issues.

Based on these Federal laws and as part of DOE's National Environmental Policy Act process and the DOE American Indian Tribal Governmental Policy, DOE requests formal consultation with the Nez Perce Tribe so that the Tribe can identify and comment on specific issues and concerns that it feels should be addressed in the TWRS EIS. To facilitate incorporation of the Nez Perce Tribe's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please recognize that this consultation letter is only part of the overall process to which DOE is committed to involving the Nez Perce Tribe in the TWRS EIS. The Draft and Final EISs will of course be formally provided for your review and comment.

Further, DOE expects to consult with the Tribe throughout the TWRS EIS process. For example, DOE is prepared to have consultation meetings or briefings where you feel that such meetings or briefings will be useful to address specific issues of importance to the Tribe. DOE and Ecology would

Ms. Donna Powaukee
95-PRI-179

-2-

welcome the opportunity to have such a meeting during the week of December 4-8, 1995, prior to the release of the draft EIS. To arrange a meeting date, time and location I will contact you by November 15, 1995.

As other useful information and consultation activities occur to you, please notify us and DOE will try to accommodate your request. Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,



Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 03 1995

95-PRI-191

Mr. Richard Buck
Wanapum People
Grant County Public Utility District
P.O. Box 878
Ephrata, Washington 98823

Dear Mr. Buck:

**THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)**

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

Consistent with various Federal laws, including the National Historic Preservation Act and the Native American Religious Freedom Act, among others, DOE and Ecology will analyze the proposed TWRS action and alternatives in terms of their impacts on cultural resources and traditional cultural properties. The EIS also will address a wide range of environmental, human health risk, and socioeconomic issues.

Based on these Federal laws and as part of DOE's National Environmental Policy Act process and Ecology's State Environmental Policy Act and the DOE American Indian Tribal Governmental Policy, DOE and Ecology requests formal consultation with the Wanapum People so that the Wanapum People can identify and comment on specific issues and concerns that it feels should be addressed in the TWRS EIS. To facilitate incorporation of the Wanapum People's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please recognize that this consultation letter is only part of the overall process to which DOE and Ecology are committed to for involving the Wanapum People in the TWRS EIS. The Draft and Final EISs, of course, will be formally provided for your review and comment.

Further, DOE expects to consult with the Wanapum People throughout the TWRS EIS process. For example, DOE is prepared to have consultation meetings or briefings where you feel that such meetings or briefings will be useful to address specific issues of importance to the Wanapum People. DOE and Ecology would welcome the opportunity to have such a meeting during the week of December 4-8, 1995, prior to the release of the draft EIS.

Mr. Richard Buck
95-PRI-191

-2-

To arrange a meeting date, time and location I will contact you by November 15, 1995.

As other useful information and consultation activities occur to you, please notify us and DOE will try to accommodate your request.

Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,



Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 08 1995

95-PRI-180

Ms. Anne Aldrich, Area Manager
U.S. Bureau of Land Management
1103 North Fancher
Spokane, Washington 99212-1275

Dear Ms. Aldrich:

THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed action and alternatives on a wide variety of environmental, human health risk, and socioeconomic issues. As part of the intergovernmental consultation required in DOE's National Environmental Policy Act process, DOE invites the U.S. Bureau of Land Management (BLM) to identify specific issues and concerns that the agency feels should be addressed in the TWRS EIS. To facilitate incorporation of BLM comments into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,

Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Upper Columbia River Basin Field Office
11103 E. Montgomery Drive, Suite #2
Spokane, WA 99206

December 12, 1995

Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
PO Box 550 MSIN S7-51
Richland, Washington 99352-0550

FWS Reference: 1-9-96-SP-028

Dear Ms. Haass:

This is in response to your letter dated November 8, 1995, and received by the Fish and Wildlife Service (Service) on November 14, 1995. Enclosed is a list of listed threatened and endangered species, and candidate species (Attachment A), that may be present within the area of the proposed Tank Waste Remediation System in Benton County, Washington. The list fulfills the requirements of the Service under Section 7(c) of the Endangered Species Act of 1973, as amended (Act). We have also enclosed a copy of the requirements for Department of Energy (DOE) compliance under the Act (Attachment B).

Should the biological assessment determine that a listed species is likely to be affected (adversely or beneficially) by the project, the DOE should request Section 7 consultation through this office. If the biological assessment determines that the proposed action is "not likely to adversely affect" a listed species, the DOE should request Service concurrence with that determination through the informal consultation process. Even if the biological assessment shows a "no effect" situation, we would appreciate receiving a copy for our information.

Candidate species are included simply as advance notice to federal agencies of species which may be proposed and listed in the future. However, protection provided to candidate species now may preclude possible listing in the future. If early evaluation of your project indicates that it is likely to adversely impact a candidate species, the DOE may wish to request technical assistance from this office.

RECEIVED

DEC 14 1995

DOE RL/CCC

195-PRI-416

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In addition, please be advised that federal and state regulations may require permits in areas where wetlands are identified. You should contact the Seattle District of the U.S. Army Corps of Engineers for federal permit requirements and the Washington State Department of Ecology for state permit requirements.

The Service has provided scoping comments in a letter addressed to Mr. Don Alexander and Mr. Geoff Tallent, dated March 16, 1994. The letter from you requesting information on the presence of threatened and endangered plant and animal species also invited the Service to identify any additional issues and concerns which should be addressed in this EIS. While it is difficult to provide meaningful comments prior to the release of the draft EIS, we make the following suggestions.

An EIS recently released by DOE developed several accident scenarios, but risk assessment was conducted only for human exposure. A risk assessment of environmental impacts from the accidental release of hazardous substances was not developed. We encourage the authors to ensure that risk assessment of environmental impacts in accident scenarios be included in this EIS.

We were informed in a recent briefing that the EIS proposes to conduct mitigation under a sitewide plan. The Biological Resources Mitigation Strategy (BRMiS), which is currently under development, has been plagued with delays and funding cuts throughout its existence. Even though the current draft of the BRMiS document is approaching completion, support for the project from various DOE programs has not been assured, and funding for implementation has not been acquired. The Service strongly recommends that the EIS commit to development and implementation of a project-specific Mitigation Action Plan in the event that the BRMiS has not been completed by the time facility construction is initiated.

Our previous letter addressed several habitat impact and mitigation issues. During the above mentioned briefing, we were informed that decisions regarding borrow sites would be made under the Hanford Remedial Action EIS. We recommend that the TWRS EIS commit to provide compensatory mitigation for any impacts to natural resources at the borrow sites even though the sites themselves have not been identified yet.

Finally, please note that Hanford issues are being handled out of our Upper Columbia River Basin Field Office in Spokane, Washington. Please send future correspondence and documents to this office.

Your interest in endangered species is appreciated. If you have additional questions regarding your responsibilities under the Act, please contact Linda Hallock at 509-921-0160, or about our comments, Liz Block at 509-765-6125.

Sincerely,

Robert J. Hallock

for Philip Laumeyer
Field Supervisor

LH

Enclosures

SE/DOE/FWS 1-9-96-SP-028/Benton

c: WDFW, Region 1

WNHP, Olympia

ATTACHMENT A

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES
AND CANDIDATE SPECIES WHICH MAY OCCUR
IN THE VICINITY OF THE
TANK WASTE REMEDIATION SYSTEM PROJECT
IN BENTON COUNTY, WASHINGTON
T13N R26E

FWS Reference: 1-9-96-SP-028

LISTED

Bald eagle (*Haliaeetus leucocephalus*) - Wintering bald eagles may occur in the vicinity from about October 31 through March 31. A communal roost site is known to occur in Section 6.

Major concerns that should be addressed in your biological assessment of project impacts to these listed species are:

1. Level of use of the project area by listed species.
2. Effect of the project on listed species' primary food stocks and foraging areas in all areas influenced by the project.
3. Impacts from project construction and implementation (e.g. increased noise levels, increased human activity and/or access, loss or degradation of habitat) which may result in disturbance to listed species and/or their avoidance of the project area.

DESIGNATED

None

PROPOSED

None

CANDIDATE

The following candidate species may occur in the vicinity of the project:

CATEGORY 2

Ferruginous hawk (*Buteo regalis*)
Fringed myotis (bat) (*Myotis thysanodes*)
*Loggerhead shrike (*Lanius ludovicianus*)
Northern sagebrush lizard (*Sceloporus graciosus graciosus*)
Olive-sided flycatcher (*Contopus borealis*)
Pale Townsend's (= western) big-eared bat (*Plecotus townsendii pallescens*)
Small-footed myotis (bat) (*Myotis ciliolabrum*)

Western burrowing owl (*Athene cunicularia hypugea*)
Western sage grouse (*Centrocercus urophasianus phaios*)
Yuma myotis (bat) (*Myotis yumanensis*) . .

*This species was erroneously omitted from the November 15, 1994
Animal Notice of Review

ATTACHMENT B

FEDERAL AGENCIES' RESPONSIBILITIES UNDER SECTIONS 7(a) AND 7(c) OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED

SECTION 7(a) - Consultation/Conference

Requires:

1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;
2. Consultation with FWS when a federal action may affect a listed endangered or threatened species to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the federal agency after it has determined if its action may affect (adversely or beneficially) a listed species; and
3. Conference with FWS when a federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or an adverse modification of proposed critical habitat.

SECTION 7(c) - Biological Assessment for Construction Projects

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which is/are likely to be affected by a construction project. The process is initiated by a federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, please verify the accuracy of the list with our Service. No irreversible commitment of resources is to be made during the BA process which would result in violation of the requirements under Section 7(a) of the Act. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an onsite inspection of the area to be affected by the proposal, which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts

including those within the FWS, National Marine Fisheries Service, state conservation department, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures; and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. Upon completion, the report should be forwarded to the Upper Columbia River Basin Field Office, 11103 E Montgomery Drive, Suite 2, Spokane, WA 99206.

* "Construction project" means any major federal action which significantly affects the quality of the human environment (requiring an EIS), designed primarily to result in the building or erection of human-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes federal action such as permits, grants, licenses, or other forms of federal authorization or approval which may result in construction.



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 08 1995

95-PRI-182

Mr. Stanley Speaks, Area Director
Bureau of Indian Affairs, Northwest Coast Area
911 Northeast 11th Avenue
Portland, Oregon 97232-4169

Dear Mr. Speaks:

**THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)**

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed action and alternatives on a wide variety of environmental, human health risk, and socioeconomic issues. As part of the intergovernmental consultation required in DOE's National Environmental Policy Act process, DOE invites the Bureau of Indian Affairs (BIA) to identify specific issues and concerns that the agency feels should be addressed in the TWRS EIS. To facilitate incorporation of BIA input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,

A handwritten signature in cursive script that reads "Carolyn C. Haass".

Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352
NOV 08 1995

95-PRI-183

Mr. Robert Christiansen
Regional Environmental Officer
U.S. Department of Interior
Bureau of Reclamation
1160 North Curtiss Road
Boise, Idaho 83706-1234

Dear Mr. Christiansen:

THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed action and alternatives on a wide variety of environmental, human health risk, and socioeconomic issues. As part of DOE's National Environmental Policy Act process, DOE invites your agency to identify specific issues and concerns that you feel should be addressed in the TWRS EIS. To facilitate incorporation of the Bureau of Reclamation's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,

A handwritten signature in cursive script that reads "Carolyn C. Haass".

Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

NOV 08 1995

Mr. Robert Christiansen
95-PRI-183

-2-

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



United States Department of the Interior

NATIONAL PARK SERVICE

Pacific Northwest Region
909 First Avenue
Seattle, Washington 98104-1060

IN REPLY REFER TO:

L7619(CCCSSO-RP)
Hanford Reach, WA-W&S

DEC 7 1995

Carolyn Haass
TWRS NEPA Document Manager
U.S. Department of Energy
Post Office Box 550
MSIN S7-51
Richland, Washington 99352-0550

Dear Ms. Haass:

Thank you for the opportunity to identify issues to be addressed in the environmental impact statement (EIS) being prepared for the planned Tank Waste Remediation System. Without a more complete description of the proposed project, we cannot provide anything more than a general overview of issues to be addressed. Our concerns center around potential impacts to the proposed wild and scenic river and national wildlife refuge. The EIS must address any impacts -- real and potential -- to the resources that make the river eligible for the National Wild and Scenic Rivers System and the upland eligible for the National Wildlife Refuge System. A complete description of these values -- including a free-flowing river and "outstandingly remarkable" resources -- can be found in the *Final Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement* prepared by the National Park Service with the assistance of the U.S. Fish and Wildlife Service. If you do not already have a copy of this document, please let us know, and we would be happy to provide you with a copy. Due to an extremely limited supply, we would not be able to supply copies to your entire study team.

Once again, thank you for an early identification of issues that might impact the interests of the National Park Service. If you have any questions with regard to this letter or the potential river designations, please do not hesitate to contact Dan Haas at (206) 220-4120.

Sincerely,

Rory D. Westberg, Superintendent
Columbia Cascades System Support Office

RECEIVED

DEC 12 1995

DOE RL/CCC
195-PRI-411 15.0



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 09 1995

95-PRI-184

Mr. Dirk Dunning
Oregon Department of Energy
625 Marion Street N.E.
Salem, Oregon 97310

Dear Mr. Dunning:

THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed action and alternatives on a wide variety of environmental, human health risk, and socioeconomic issues. As part of DOE's National Environmental Policy Act process, DOE invites your agency to identify specific issues and concerns that you feel should be addressed in the TWRS EIS. To facilitate incorporation of the Oregon Department of Energy's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,

A handwritten signature in cursive script that reads "Carolyn C. Haass".

Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington: 99352

NOV 08 1995

95-PRI-185

Mr. Richard Truitt, Director
Environmental Health and Engineering
Portland Area Indian Health Service
1220 S.W. 3rd Avenue, Room 476
Portland, Oregon 92704

Dear Mr. Truitt:

**THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)**

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed action and alternatives on a wide variety of environmental, human health risk, and socioeconomic issues. As part of DOE's National Environmental Policy Act process, DOE invites your agency to identify specific issues and concerns that you feel should be addressed in the TWRS EIS. To facilitate incorporation of the Portland Area Indian Health Service's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please address your response to:

Ms. Carolyn Haass
TWRS EIS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,

A handwritten signature in cursive script that reads "Carolyn C. Haass".

Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352
NOV 08 1995

95-PRI-186

Ms. Mary Thompson
State Historic Preservation Officer
Office of Archaeology and Historic
Preservations
Washington Department of Community
Trade and Economic Development
P.O. Box 48343
Olympia, Washington 95804-8343

Dear Ms. Thompson:

THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 East or 200 West Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

In accordance with 36 CFR 800.4 and 35 CFR 800.4 (d) of the National Historic Preservation Act, DOE's Richland Operation Office (RL) has made a good faith effort to identify properties of potential prehistoric and historic significance in the areas where TWRS facilities are proposed for development. The TWRS facilities will be situated within the 200 East Area of the Central Plateau at the Hanford Site.

As indicated in letters from RL to your office dated August 25, 1994, and October 4, 1994 (Attachment), cultural resources surveys have been conducted in the areas that may be affected by the proposed action. DOE requests your determination whether these resources are eligible for inclusion on the National Register of Historic Places. Previous cultural resources literature and records searches, as well as Site surveys, indicate that no historic properties eligible for the National Register will be affected by the planned TWRS facilities.

Further, as part of DOE's National Environmental Policy Act process, DOE invites your agency to identify any additional issues and concerns that you feel should be addressed in the EIS. To facilitate incorporation of the Washington State Historic Preservation Office's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

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Ms. Mary Thompson
95-PRI-186

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As mentioned above, Ecology is co-preparer of the TWRS EIS with DOE. Please coordinate your response to this letter with Mr. Geoff Tallent, Ecology Project Manager for the TWRS EIS.

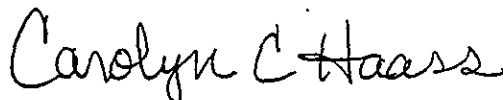
Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

Mr. Geoff Tallent, Project Manager
State of Washington
Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600

If you have any questions, please contact me on (509) 372-2731.

Sincerely,



Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

Attachment

cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 08 1995

95-PRI-188

Mr. Charles Odegaard, Regional Director
National Park Service
National Park Service, Pacific Northwest
909 1st Avenue
Seattle, Washington 98104

Dear Mr. Odegaard:

**THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)**

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed action and alternatives on a wide variety of environmental, human health risk, and socioeconomic issues. As part of the intergovernmental consultation required in DOE's National Environmental Policy Act process and Ecology's State Environmental Policy Act process, DOE and Ecology invites the National Park Service to identify specific issues and concerns that the agency feels should be addressed in the TWRS EIS. To facilitate incorporation of the National Park Service's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,

A handwritten signature in cursive script that reads "Carolyn C. Haass".

Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

Mr. Charles Odegaard
95-PRI-188

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cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 08 1995

95-PRI-189

Mr. Forester Einarson
U.S. Army Corps of Engineers
Office of Environmental Policy
Pulaski Building, Room 7116
20 Massachusetts Avenue N.W.
Washington, D.C. 20314-1000

Dear Mr. Einarson:

THE U.S. DEPARTMENT OF ENERGY (DOE) TANK WASTE REMEDIATION SYSTEM (TWRS)
ENVIRONMENTAL IMPACT STATEMENT (EIS)

The DOE and the Washington State Department of Ecology (Ecology) are jointly preparing the TWRS EIS. The TWRS EIS will address DOE's plans for safe management, treatment, storage, and disposal of radioactive, chemical, and mixed wastes stored in 177 underground storage tanks and of cesium and strontium wastes stored in capsules at the Waste Encapsulation Storage Facility. The tank wastes, strontium and cesium capsules, and the proposed TWRS project facilities, are all located in the 200 Areas of the Central Plateau at the DOE Hanford Site in Richland, Washington.

The TWRS EIS will address the impacts of the proposed actions and alternatives on a wide range of environmental, human health risk, and socioeconomic issues. As part of the intergovernmental consultation required in DOE's National Environmental Policy Act process and Ecology's State Environmental Policy Act process, DOE and Ecology invites the U.S. Army Corps of Engineers (USACE) to identify specific issues and concerns that the USACE feels should be addressed in the TWRS EIS. To facilitate incorporation of USACE's input into the Draft EIS, a written response is needed within 30 days upon receipt of this letter.

Please address your response to:

Ms. Carolyn Haass
TWRS NEPA Document Manager
Department of Energy
P.O. Box 550 MSIN S7-51
Richland, Washington 99352-0550

If you have any questions, please contact me on (509) 372-2731.

Sincerely,

A handwritten signature in cursive script that reads "Carolyn C. Haass".

Carolyn C. Haass
TWRS NEPA Document Manager

PRI:CCH

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Mr. Forester Einarson
95-PRI-189

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cc: D. Nichols, Jacobs
G. Tallent, Ecology
E. Cohen, EH-42
E. LeDuc, GC-51